UPPER·MIDDLE MAINSTEM

Subbasin Plan

Prepared for the Northwest Power & Conservation Council

Upper Middle Mainstem Subbasin

5/28/2004

Prepared for the

Northwest Power and Conservation Council

1 Introduction

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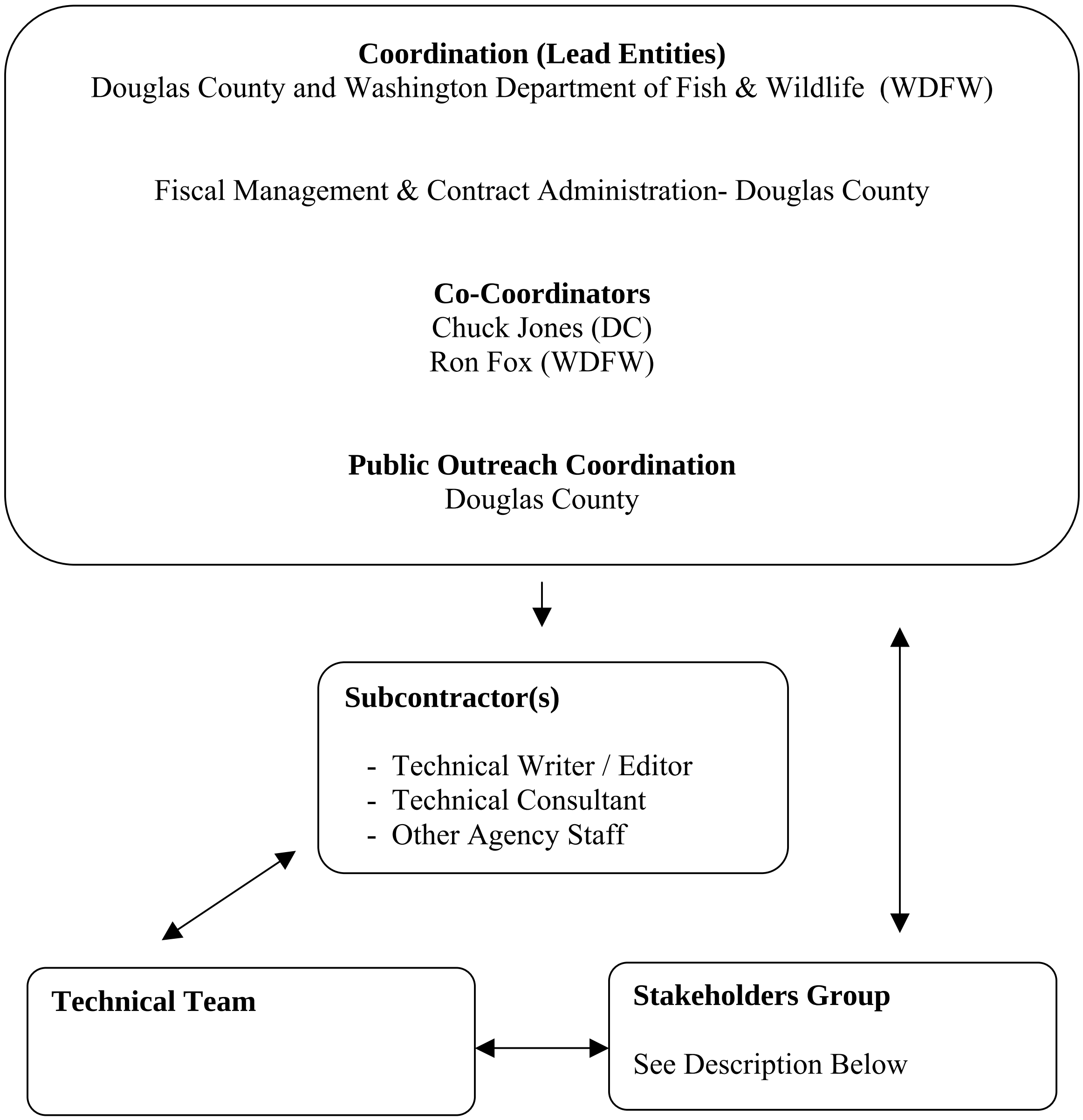
1.2 Subbasin Plan Approach and Public Involvement

1.2.1 Description of Planning Organization

Infrastructure and Organization

Douglas County, in conjunction with Washington Department of Fish and Wildlife (WDFW) developed this subbasin plan for the UMM Subbasin with guidance from the *Technical Guide for Subbasin Planners* (NPPC 2001-20). Fish and wildlife population and habitat management goals and objectives, including harvest, natural and hatchery production were collected and described from numerous resources. Strategies to meet goals for habitat protection and restoration have been prioritized in collaboration with local stakeholders in the planning process. Consistent with subbasin summaries completed for provincial reviews, the geographic scope of the Subbasin Plan includes the Columbia River and tributary drainages, although the Columbia River relies on and refers extensively to existing Habitat Conservation Plans and FERC relicensing documents. Subbasin Planners used the following organizational structure in developing the subbasin plan.

Upper Middle Mainstem Subbasin Organizational Structure



Stakeholders: The primary stakeholder involvement mechanism is the Watershed Planning Unit because of the participation, representation, and well-attended meetings. Stakeholders include representatives from multiple organizations, primarily through a collaborative effort administered by Foster Creek Conservation District, that represent cities, counties, irrigation districts, state agencies and federal land and resource management agencies

1.2.2 Mission Statement

Restore and maintain healthy indigenous fish and wildlife populations and their ecosystems to support sustainable harvest, cultural values, and non-consumptive benefits through a local, state, tribal, and federal partnership. Management decisions will be made in an open and cooperative coordinated process that respect different points of view, and will adhere to varied rights and statutory responsibilities.

1.2.3 Approach

Douglas County and the WDFW partnered to coordinate Subbasin Planning for the UMM Subbasin. Douglas County has been primarily responsible for sub-contracting, outreach and public involvement, whereas WDFW focused on technical components. Both entities spent much of their time in coordinating all of these efforts.

The timeline established by the Northwest Power and Conservation Council (NPCC) has necessitated a very compressed process that has allowed little flexibility in stakeholder involvement. The rigorous schedule and limited budget have restricted the time available for outreach. However, Douglas County has devoted resources to public outreach such as using the County website, public meetings, Regional Planning Commission information sessions and use of the Douglas County Watershed Planning Association as the primary stakeholder group. The NPCC's proposed three year rolling review of subbasin plans, will make the plans relevant, enable them to be updated regularly, and to be adapted to new knowledge and information.

Outreach

In February 2003 the Coordinators and Foster Creek Conservation District agreed that the Douglas County Watershed Planning Association would work as the primary stakeholder group to reduce duplication and relying on stakeholders to come to multi-purpose meetings. In the fall of 1998, the initiating governments in the Foster Creek and Moses Coulee watershed basins chose to work together to form the Douglas County Watershed Planning Association for WRIA's 44 and 50. These initiating governments include Douglas County, Grant County, Okanogan County, City of East Wenatchee, City of Bridgeport, Bridgeport Irrigation District #1, East Wenatchee Water District, and the Colville Confederated Tribes. The initiating governments created an intergovernmental agreement for the purpose of administering the development of a local watershed plan and to designate Foster Creek Conservation District as lead agency.

The Planning Unit consists of a wide representation of the local community. The group has met monthly since 1999. All members or their alternates are expected to attend. Decisions are made on a consensus basis. Consensus, as agreed upon by the Unit, will allow every member to say, "I can live with the decision and accept it, even though it may or may not be exactly what I want." The commitment is to a collective well-being and not to an individual's needs. Members come with a 'solution-oriented' vision for the health of the community, the water resources which sustain it, and the abundant wildlife present.

Fact sheets

Douglas County developed several Fact Sheets to introduce Subbasin Planning to stakeholders and the media and explain opportunities for public involvement. The Fact Sheet included a telephone number and email, postal mail, and web site addresses that individuals could use to obtain more information. Opportunities for public involvement in the UMM Subbasin Planning process are detailed in **Table 1** below.

Table 1 Public participation in UMM Subbasin planning

Date	Subject	Where or Who
Nov. 20, 2002	Subbasin planning- workplan development	Douglas County Regional Planning Commission (DCRPC)

Date	Subject	Where or Who
Feb. 20, 2003	Subbasin planning- 101 Workshop	Douglas County Watershed Planning Unit (WPU)
Mar. 05, 2003	Website development	Douglas County Website- Natural Resources Sxn Created w/SBP
June 26, 2003 Sept. 25, 2003	Subbasin planning update Subbasin planning update	WPU WPU
Oct. 22, 2003	Subbasin planning basics and update	Joint RPC and City of E. Wenatchee Planning Comm.
Nov. 20, 2003	Subbasin planning update	WPU
Dec. 15, 2003	Display- subbasin planning and regional salmon recovery	Douglas County Public Services Bldg.
Jan. 21, 2004	SBP update on assessment, folders/handouts, focal spp, wildlife	DCRPC
Feb. 05, 2004	SBP update on assessment, folders/handouts, focal spp	WPU, public, advertised
Mar. 10, 2004	Subbasin planning update	Regional Technical Team presentation
Mar. 10, 2004	Subbasin planning update	Bridgeport City Council
Mar. 24, 2004	Subbasin planning update	WPU
Mar. 25, 2004	SBP summarized product and results, folders/handouts, maps	Regional Planning Commission, public, advertised
Apr. 14, 2004	Subbasin planning update	Eastern Washington Planners Forum- Moses Lake
Apr. 21, 2004	SBP summarized product and results, folders/handouts, maps	Regional Planning Commission, public, advertised
Apr. 22, 2004	Subbasin planning update	WPU
May 13, 2004	SBP summarized product and results, folders/handouts, maps	Public, advertised, 100-200 people emailed
May 19, 2004	SBP summarized product and results, foders/handouts, maps	Regional Planning Commission, public, advertised

(This does not include technical or USCRB related meetings)

1.2.4 Acknowledgements

We would like to thank all of those who participated in the development of this report, particularly the following organizations for their commitment during the planning process: North Central Washington Resource Conservation and Development Council for their assistance in the Level 2 contract maintenance, The Upper Columbia Salmon Recovery Board for assisting with direction of the regional planning processes, and The Upper Columbia Regional Technical Team, NOAA Fisheries Technical Review Team, and Washington Department of Fish and Wildlife staff who provided direction and support to those mentioned in the list of participants. We also thank Douglas County Transportation and Land Services staff for GIS and data entry assistance.

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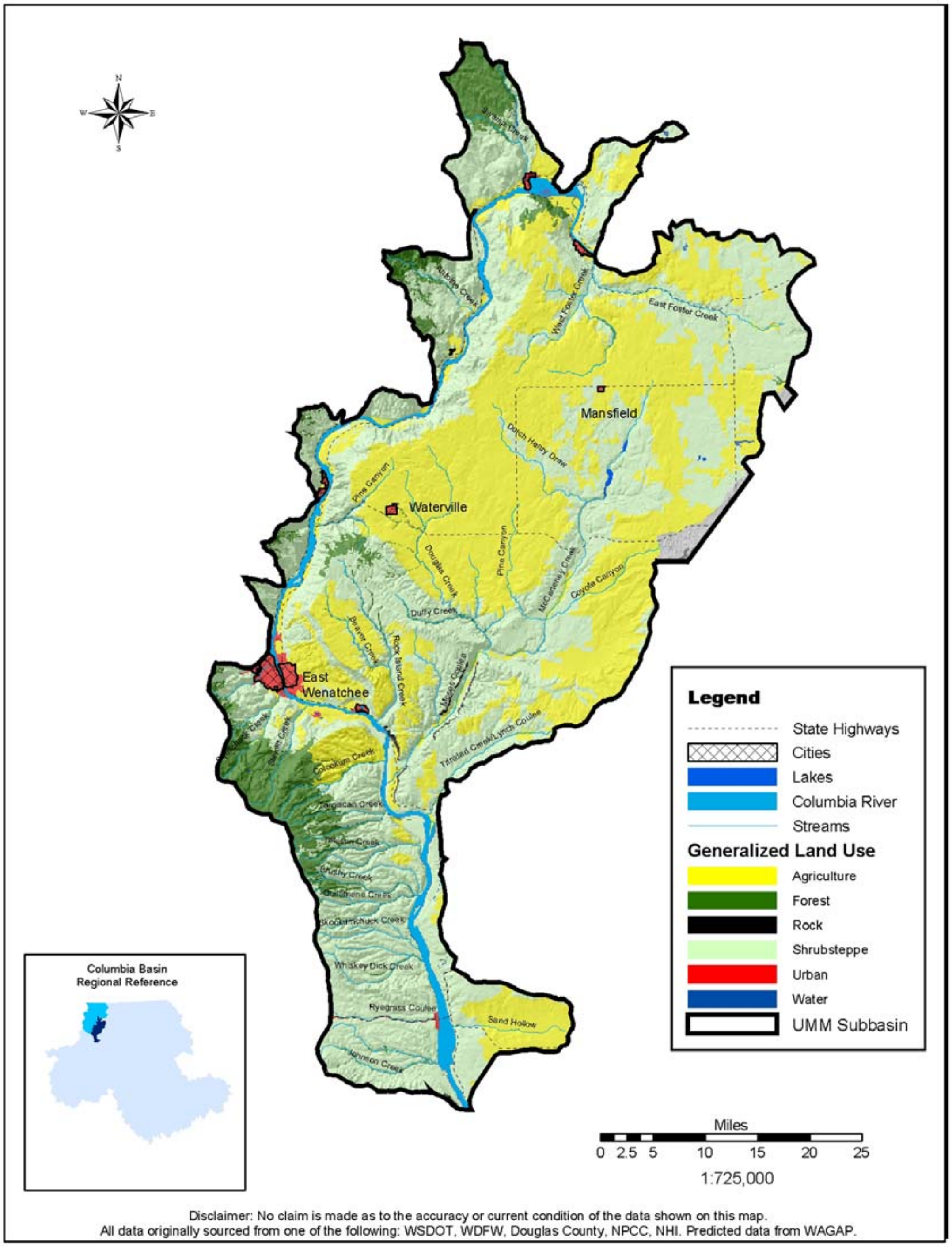
2 Executive Summary

2.1.1 Purpose and Scope

In October of 2000, the Northwest Power Planning Council adopted a revised Fish and Wildlife Program (Program) for the Columbia River Basin. The new program is intended to be more comprehensive than, but complimentary to, regional efforts related to the Endangered Species Act, state-sponsored recovery, watershed planning, and coordination efforts, and tribal recovery initiatives. The revised Program calls for an ecosystem-based approach for planning and implementing fish and wildlife recovery. The focus of the planning effort is to fulfill the obligations within the Northwest Power Act and not intended to supercede other similar efforts, such as the Mid Columbia Habitat Conservation Plan or Federal Energy Regulatory Commission relicensing efforts, but possibly to enhance and/or incorporate those efforts to better plan for fish and wildlife resources.

The Program divides the Columbia Basin into ecological provinces that are further divided into individual subbasins. At the heart of the Program are subbasin plans, consisting of a comprehensive description of the basins general ecology including the identification of specific fish and wildlife needs. The Upper Middle Mainstem Subbasin (Figure 1) Plan is one of six subbasin plans being generated in the CCP. The Okanogan, Wenatchee, Lake Chelan, Entiat, and Methow Subbasins comprise the remainder of this CCP. Future action strategies and project funding are to be based upon these identified needs.

The *UMM Subbasin Summary* (Peven 2002) presented a compilation of known and existing data on anadromous and resident fish, wildlife, and their habitats. The report also provides data and context, land use, human population patterns, and overall resource management issues. The UMM Subbasin Plan draws from the important information assembled in the Subbasin Summary (updated where appropriate), and draws from a significant body of information to facilitate coordinated planning. The Subbasin Plan addresses the limiting factors for fish and wildlife populations & habitats, however the needs of area residents and their critical role in ecosystem stewardship have been expressly considered as part of overall ecosystem recovery and its benefits.



(DCTLS 2004)

Figure 1 UMM Subbasin location, topography, land use, demographics, and hydrology

2.1.2 Subbasin Goal - Vision Statement

The Vision Statement for the Upper Middle Mainstem Subbasin is largely based on the Douglas County Watershed Planning Association Goal Statements for water resources. They are based on a sustainable future for the landscape, the economy, and the people within the Subbasin.

Our vision for the landscape is to balance habitat conservation with human uses to ensure the long-term health of plant, fish, wildlife and human communities.

Our vision for the economy is based on efficient management and use of natural resources including reliable water supplies, fish and wildlife populations, and aquatic and terrestrial habitats.

Our vision for the people is to manage natural resources to promote social and economic well-being and to improve or maintain our quality of life. We will work together to foster increased understanding of the importance of natural resource conservation.

Biological Objectives

Biological objectives describe physical and biological changes within the subbasin needed to achieve the vision and address factors affecting focal habitats. Biological objectives for all Ecoregion subbasins are habitat based and describe priority areas and environmental conditions needed to achieve functional focal habitat types. Where possible, biological objectives are empirically measurable and based on an explicit scientific rationale (the working hypothesis). Biological objectives are:

- Consistent with subbasin-level visions and strategies
- Developed from a group of potential objectives based on the subbasin assessment and resulting working hypotheses
- Realistic and attainable within the subbasin
- Consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin, and agreed upon by co-managers in the subbasin
- Complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin
- Quantitative and have measurable outcomes where practical

2.1.3 Major Findings and Conclusions

The analysis and synthesis of information in this subbasin plan is summarized as follows:

- Columbia River water is managed at a much larger scale than the subbasin or province, and within the subbasin and province most of the fisheries management is guided through existing legal agreements (HCP, FERC, ESA etc.).
- Small tributaries in the UMM Subbasin are generally thought to be in better shape than initially thought, although certain areas need significant improvements to be functional or accessible to anadromous and resident fish. In addition, data is severely lacking in many of the tributaries and is needed to develop better strategies for fish or wildlife in those areas.
- Shrubsteppe and herbaceous wetlands are the two dominant habitat types within the UMM and this subbasin contains some of the most important shrubsteppe habitat in the state for several species. WDFW, BLM, and The Nature Conservancy are the largest landowners that

specifically manage for natural resources in the subbasin. Also, there are substantial conservation programs (e.g. CRP etc.) designed to assist private landowners in managing their lands to conserve natural resources.

3 Subbasin Overview

The Subbasin Overview has four main sections. The first section, Subbasin in Regional Context, describes the UMM Subbasin and its place within the CCP and the greater Columbia River Basin as defined by the Northwest Power and Conservation Council (NPCC). The second and third sections, CCP and Subbasin Description, summarize the geological, climatic, biological, hydrological, and anthropogenic characteristics of the CCP and UMM Subbasin, respectively. The fourth, the Guiding Principles, articulates and merges biological and management assumptions to provide a framework for developing the UMM Subbasin Plan.

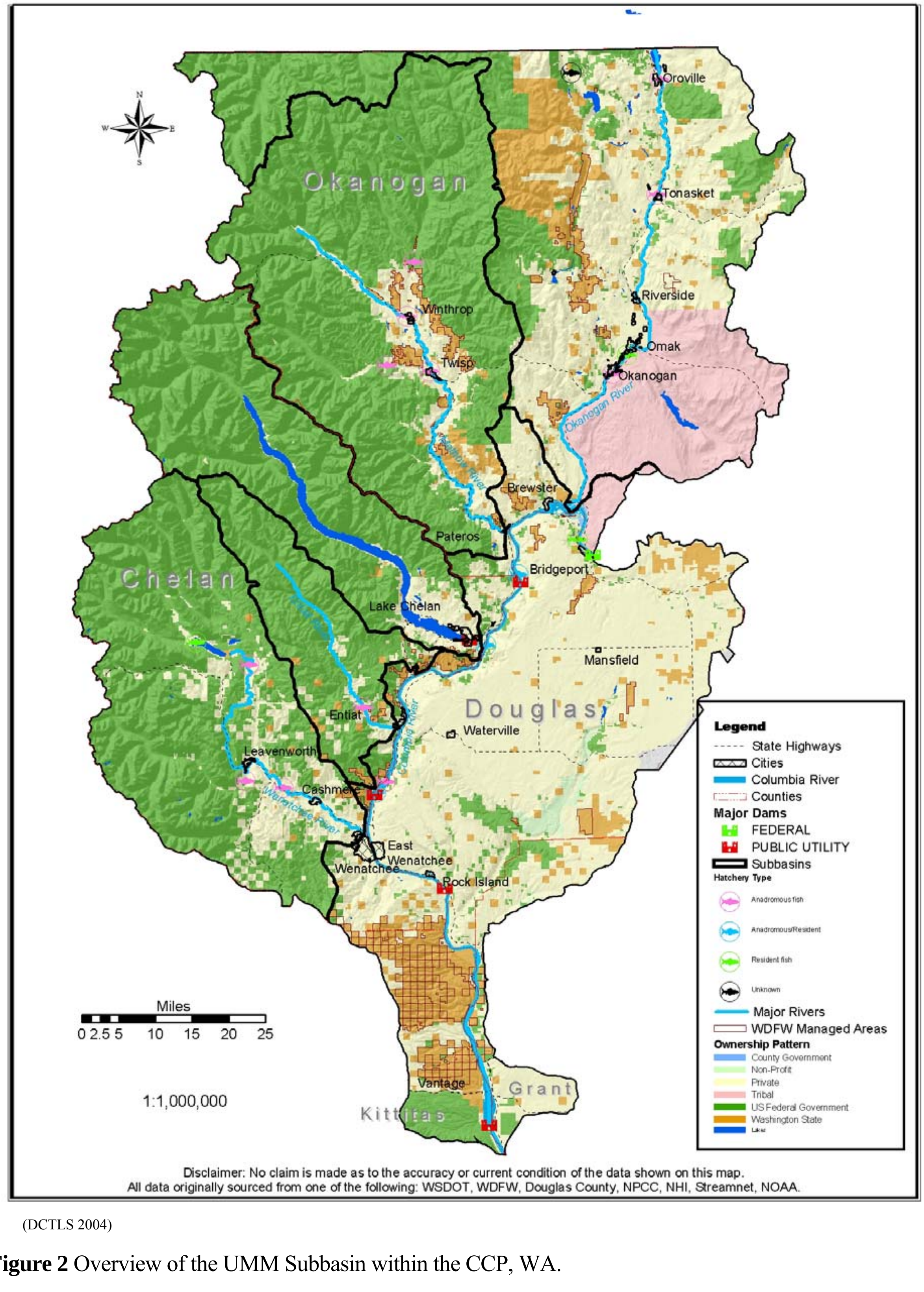
3.1.1 Subbasin in Regional Context

For planning purposes, the NPCC divided the Columbia River Basin south of the Canadian border and its more than 60 subbasins into 11 CCPs. NPCC is responsible for implementing the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 96-501) and the Fish and Wildlife Program mandated by the Act.

The 11 Provinces, beginning at the mouth of the Columbia River and moving inland, are: Columbia Estuary; Lower Columbia; Columbia Gorge; Columbia Plateau; Columbia Cascade; Inter-Mountain; Mountain Columbia; Blue Mountain; Mountain Snake; Middle Snake; Upper Snake. These 11 Provinces include the entire Columbia River Basin in the United States, and together cover approximately 25,000 sq. mi. in Washington, Oregon, Idaho, and Montana.

Each of the 11 Provinces will develop its own vision, biological objectives, and strategies consistent with those adopted at the subbasin level. NPCC's intent is to adopt these elements into the 2000 Fish and Wildlife Program during later rulemaking. The biological objectives at the CCP scale will then guide development of the program at the subbasin scale.

The Provincess are made up of adjoining groups of ecologically related subbasins, each Province distinguished by similar geology, hydrology, and climate. Because physical patterns relate to biological population patterns, fish and wildife populations within a Province are also likely to share life history and other characteristics (NPCC 2000). The UMM Subbasin is in the CCP (Figure 2).



(DCTLS 2004)

Figure 2 Overview of the UMM Subbasin within the CCP, WA.

3.1.2 Columbia Cascade Province

The Columbia Cascade Province (CCP) is the fourth smallest of the ecological Provinces and covers an area of approximately 9,407 sq. mi (Figure 2). It is defined as the Columbia River and all tributaries from Chief Joseph Dam to Wanapum Dam. This area includes much of north-central Washington. The CCP is divided into six subbasins: Lake Chelan, Okanogan, Methow, Entiat, Wenatchee, and Upper Middle Mainstem (CBFWA 2003).

The Cascade Mountains form the western border of the CCP, and the U.S. / Canada border forms the northern edge. The northeastern corner of the CCP passes through the Okanogan National Forest and the Colville Indian Reservation, while the southeastern boundary is bordered by Banks Lake, Lake Lenore State Wildlife Area, and the towns of Ephrata and Quincy. Wanapum Dam lies at the southern tip of the CCP.

The CCP overlies two significantly different physiographic regions and topography varies widely (10,000 ft. at Glacier Peak to 600 ft. at the Columbia River). The Cascade Mountains, to the north and west, consists primarily of metamorphosed sedimentary, volcanic and granitic rock, while the Columbia Plateau, to the east and south, features vast thick layers of basaltic bedrock. The hydrology of the CCP is complex; surface water includes numerous small tributaries draining to the Columbia River, while underlying the region is the Columbia Plateau Regional Aquifer System.

Temperatures and precipitation within the UMM Subbasin also vary significantly, usually depending on elevation, with cooler and wetter climates in the mountainous areas in the western and northern sections of the CCP, and arid to semi-arid climates in the eastern and southern portions of the CCP.

Vegetation communities follow elevation and moisture gradients. At the highest elevations subalpine and alpine meadow grasses and forb species occur and give way to subalpine fir communities below the Cascade Crest. At mid-elevations a transition from Douglas fir communities to the dominant ponderosa pine forests occurs on moisture and elevation gradients. At the lowest elevations, an arid continental climate occurs and shrubsteppe and steppe plant communities (shrubs, perennial bunch grasses, lichens, and mosses) dominate the landscape. High water table or seasonal flooding conditions found adjacent to lakes, streams and rivers support development of deciduous riparian communities.

Federal lands, including the Okanogan and Wenatchee National Forests make up most of the Western section and small portions of the northeastern section of the CCP. The western one-third (341,051 acres) of the Colville Indian Reservation is also located within the CCP (southeast portion of the Okanogan subbasin) and much of remaining CCP lands are in private ownership. The western portion of the CCP is predominantely coniferous forest, while the eastern portion is comprised primarily of agricultural lands, shrubsteppe and steppe habitat.

The CCP is an important agricultural and grazing area and also encompasses several urban areas. Orchards and small areas of irrigated cropland are found along the Columbia River corridor between Chief Joseph and Rock Island dams. Most of the eastern UMM Subbasin is a plateau where dryland farming and rangelands are the dominant agricultural practices. Much of the Grant County portion of the UMM Subbasin is part of the Columbia Reclamation Irrigation Project and has extensive irrigated agriculture. Significant urban centers within the CCP include Wenatchee, East Wenatchee, Entiat, Chelan, Pateros, Brewster, Winthrop, Leavenworth, Cashmere, Waterville, Bridgeport, and Okanogan/Omak, Washington. The Greater Wenatchee Area is the largest urban center with a total population of 48,952 (East Wenatchee urban areas, U.S. Census 2000). The western one-third (341,051 acres) of the Colville Indian Reservation is also located within the CCP.

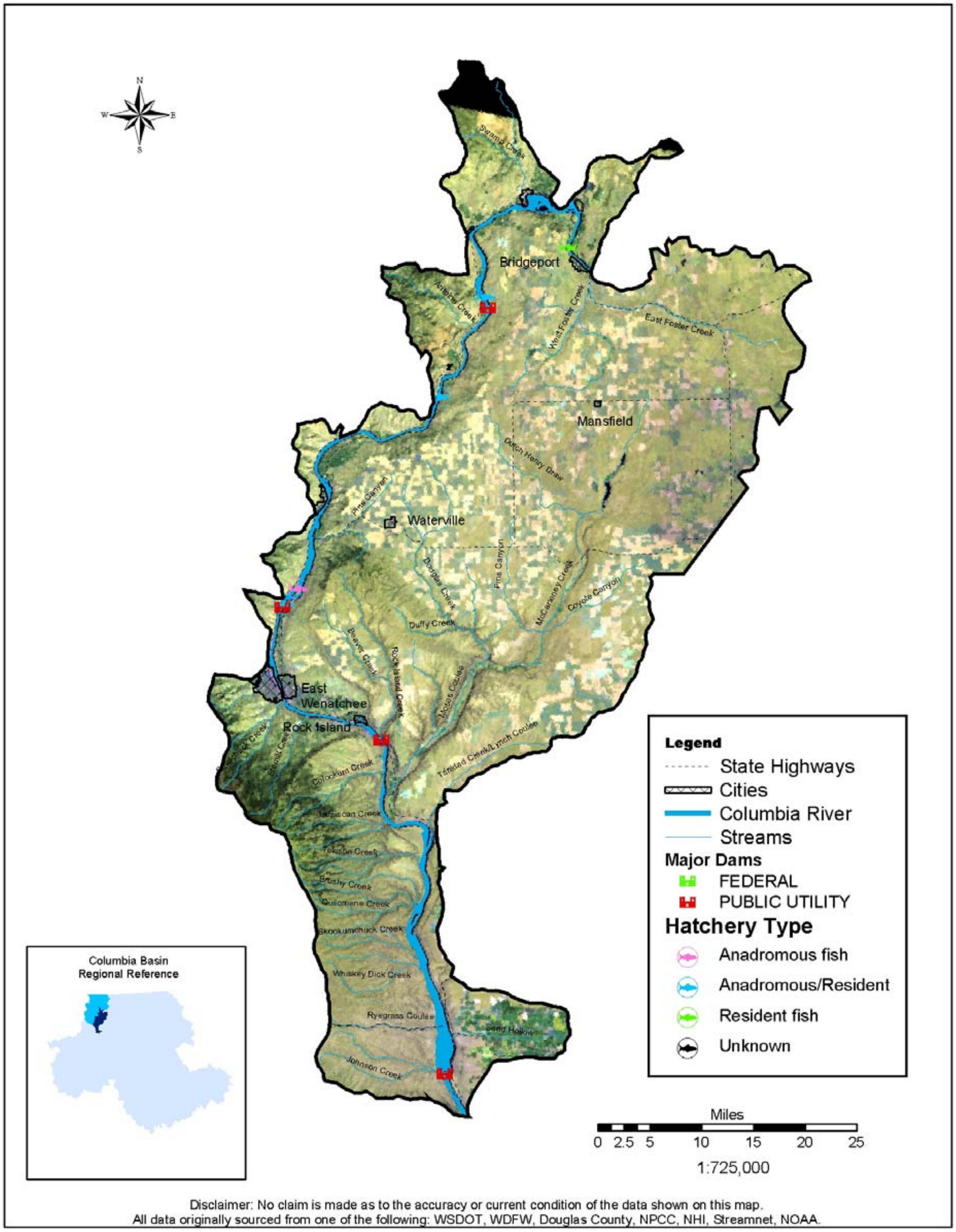
The CCP is also a significant source of hydroelectric power. Five major Columbia River dams are located within the CCP: Chief Joseph, Wells, Rocky Reach, Rock Island, and Wanapum dams. Five more dams lie downstream on the Columbia River: Priest Rapids, McNary, John Day, The Dalles, and Bonneville dams. All hydro-projects listed, with the exception of Chief Joseph Dam, have fish passage facilities and also provide downstream passage for juvenile salmonids (through collection facilities or fish spill). These dams provide an economical power supply and numerous recreational and economic benefits.

3.2 Subbasin Description

The majority of the UMM Subbasin (Figure 3) is in Douglas County with lesser amounts in Okanogan, Chelan, Kittitas, and Grant Counties. The UMM Subbasin comprises 17.5 percent of the CCP (Figure 3 Upper Middle Mainstem Subbasin, WA.

Table 2), and consists of 1,607,740 acres (2,512 mi^2). The UMM Subbasin extends from Chief Joseph Dam (Rkm 877, Rm 545.1) to Wanapum Dam (Rkm 669, Rm 415.8) and contains Wells, Rocky Reach, Rock Island and Wanapum dams and reservoirs.

Below Chief Joseph Dam, the Columbia River flows in a westerly direction and turns south at the eastern edge of the Cascade Mountains. Several minor tributaries and drainages join this stretch of the Columbia and are included within the UMM Subbasin. These include: Foster, Rock Island, and Moses Coulee creeks in Douglas County; Squilchuck, Stemilt, and Colockum creeks in Chelan County; Trinidad Creek and Sand Hollow Wasteway in Grant County; and Tarpiscan, Tekison, Brushy, Quilomene, Whiskey Dick, and Johnson creeks in Kittitas County. Jameson and Grimes Lakes are also included in this subbasin. The two largest watersheds located within the UMM Subbasin are Foster Creek (WRIA 50) and Moses Coulee (WRIA 44).



(DCTLS 2004)

Figure 3 Upper Middle Mainstem Subbasin, WA.

Table 2 Subbasin size relative to the CCP and WA. State (IBIS 2003)

Subbasin	Size		Percent of CCP	Percent of State
	Acres	Mi^2		
Enitat	298,363	466	3.2	.7
Lake Chelan	599,925	937	6.5	1.4
Wenatchee	851,894	1,333	9.3	2.0
Methow	1,167,795	1,825	12.7	2.8
Okanogan	1,490,079	2,328	16.2	3.5
Upper Middle Mainstem	1,607,740	2,512	17.5	3.8
Crab	3,159,052	4,936	34.4	7.4
Total (CCP)	9,174,848	14,337	100	21.6

3.2.1 Topographic/Physio-geographic Environment

Geology

Three physiographic Provinces influence the geology of the UMM Subbasin: the Columbia Mountain/Highlands to the north, the North Cascade Range to the west and the Columbia Basalt Plain to the east and south. The Columbia River flows over mainly Paleozoic metamorphic and intrusive rocks north of Rock Island Dam, while south of the dam the river passes through the Columbia basalt group (BPA et al. 1994).

Bordered by the North Cascade Range, the topography on the west side of the Columbia River is generally steep with slopes greater than 60 percent. Elevations change quickly from 4,200 feet at Burch Mountain to 700 feet at Rocky Reach Dam. Most tributary streams on the western edge of the UMM Subbasin flow from west to east into the Columbia River and are high gradient streams capable of transporting large volumes of water and sediment during the spring runoff period. Large alluvial fans are common in the areas where the major tributaries meet the Columbia River.

On the east side of the Columbia River, elevations also rise quickly from 700 feet to 4,100 feet at Badger Mountain. Most of the eastern UMM Subbasin is best described as a plateau where slopes are not as steep and the landscape has the appearance of rolling hills rather than mountains. Major landforms within the eastern portion of the UMM Subbasin include Dyer Hill, Waterville Plateau, Moses Coulee, and the Badger Mountain area.

A wide variety of soils occur in the UMM Subbasin. Soils range from light-colored, with thin A horizons poor in organic matter and calcium accumulations high in the profile to thick, very dark-brown to black A horizons rich in organic matter in which calcium carbonate accumulations may be deep in the profile or absent. Soils with high accumulations of salt and large amounts of exchangeable sodium are also present (MCMCP 1995).

Climate and Weather

Located in the rain shadow of the Cascade Mountain Range, the UMM Subbasin is classified as arid to semiarid with low levels of annual precipitation, cold winters and hot, dry summers.

Precipitation can vary widely in relation to topographic features but in general much of the subbasin receives less than 15 inches of annual precipitation and most of that precipitation falls in winter. Nearby, the upper Cascade Mountains sometimes receive more than 100 inches of snowfall per year. Cool winter temperatures maintain most of this snowpack as natural storage until spring when its runoff adds to flows in the Columbia River. Snowpack accumulation is dependent on storm systems moving inland to central Washington from the Pacific Ocean during the winter months (Peven 2002).

Air temperatures vary widely depending on topography and location within the subbasin. Summertime air temperatures generally exceed 100 ºF for one to several days each year. Winter temperatures can also drop below 0 ºF, but in general they are in the 20 to 40 ºF range. Along the Columbia River, winter and spring air temperatures remain very stable. The growing season ranges from 170 days (May-September) at Bridgeport and East Wenatchee to 135 days on the eastern plateau (Peven 2002).

Vegetation

Vegetation in the UMM Subbasin consists mainly of steppe and shrub-steppe vegetation (Table 3). Forest vegetation is generally confined to mountain slopes with sufficient precipitation (MCMCP 1995). Present vegetative communities vary widely from historic conditions because much of the UMM Subbasin is cultivated or grazed by livestock.

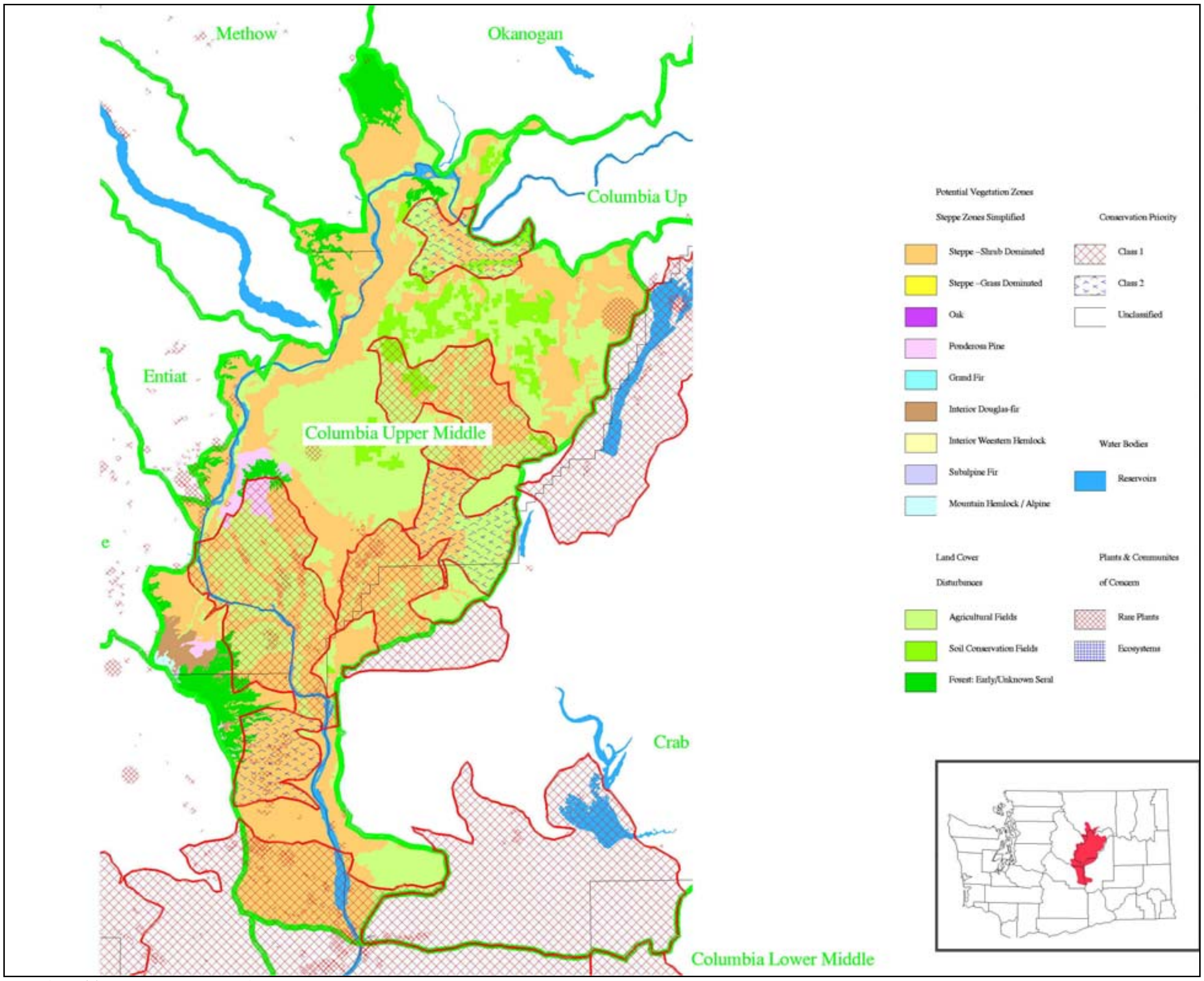
Table 3 Land types and acreage in the UMM Subbasin, WA.

Basic Land Type	Acres	Percent
Agriculture	744,828	12.4
Forest	3,477,765	57.8
Rock	2,766	0.0
Shrub/Steppe	1,667,509	27.7
Urban	31,227	0.5
Water	90,742	1.5
TOTAL	6,014,837	

*Washington GAP Analysis Data- total difference because of data alignment with Canadian Border in GIS.

Rare Plant Communities

The UMM Subbasin contains 91 rare plant communities (Table 1, Appendix A). Approximately 30 percent of the rare plant communities are associated with shrubsteppe habitat, 20 percent with riparian or wetland habitats, and 50 percent with upland forest habitat. Rare/high-quality plant occurrences and communities are illustrated in (Figure 4).

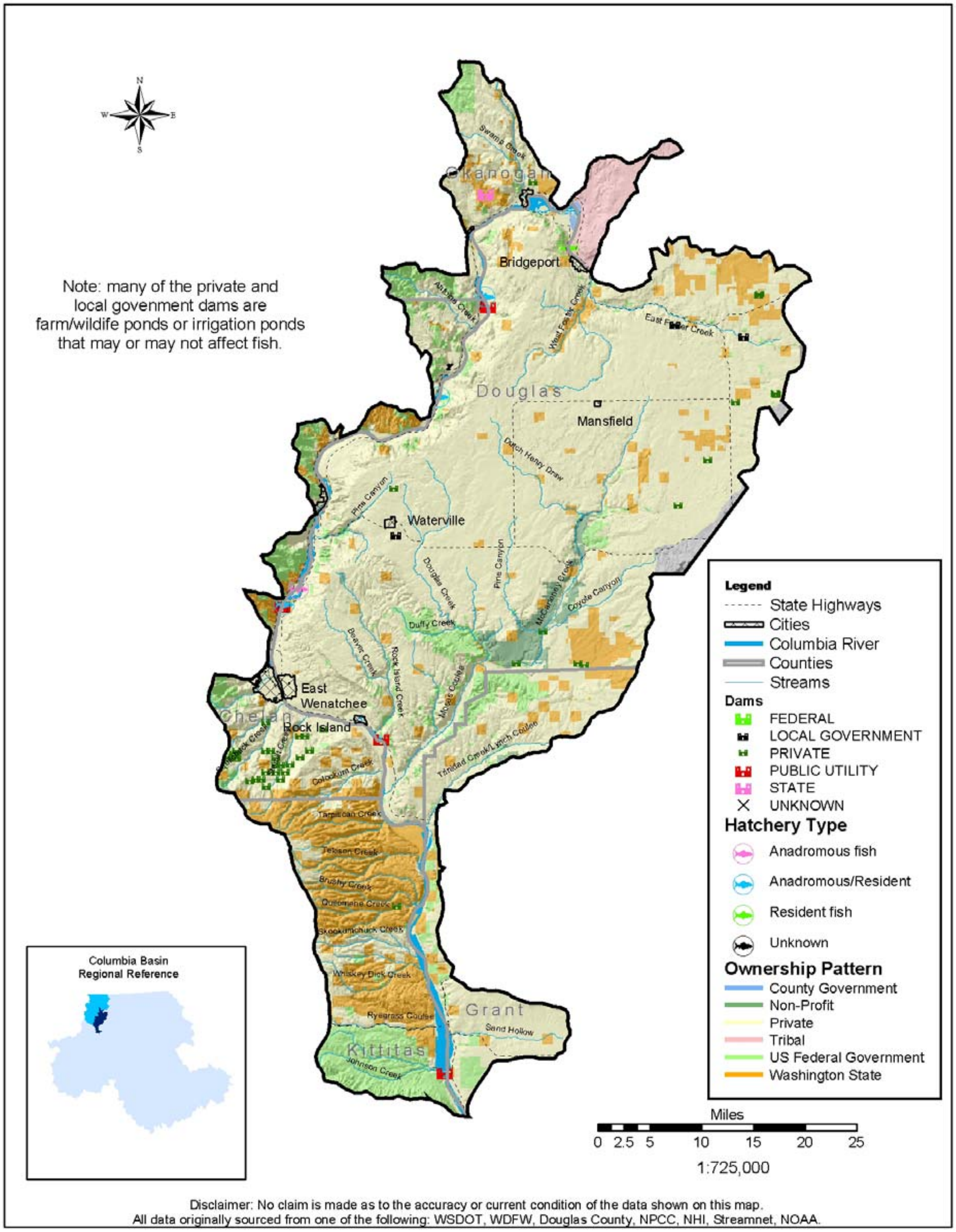


(Cassidy 1997, WNHP 2003)

Figure 4 Rare plant occurrence and high quality plant communitities in the UMM Subbasin, WA

3.2.2 Jurisdictions and Land Ownership

Approximately 27 % of the UMM Subbasin is in federal, state, tribal, and local government ownership, while the remaining 73 % is privately owned or owned by non-government organizations (NGOs) (Figure 5 and Table 4). Privately held lands in the Subbasin comprise 12 % of the entire CCP (Table 5).



(DCTLS 2004)

Figure 5 Land ownership in the UMM Subbasin, WA.

Table 4 Land ownership in the UMM Subbasin, WA. (based on parcel level data from Chelan, Douglas, Grant, and Okanogan counties and WDFW data for Kittitas County)

Owner	Acres	Percent
County Government (partial)	1,216	0.02
Private	2,189,878	35.1
Tribal	341,051	5.5
US Federal Government	3,011,173	48.3
Washington State	694,273	11.1
TOTAL	6,237,591	

Table 5 Land Ownership of the CCP, WA. (IBIS 2003)

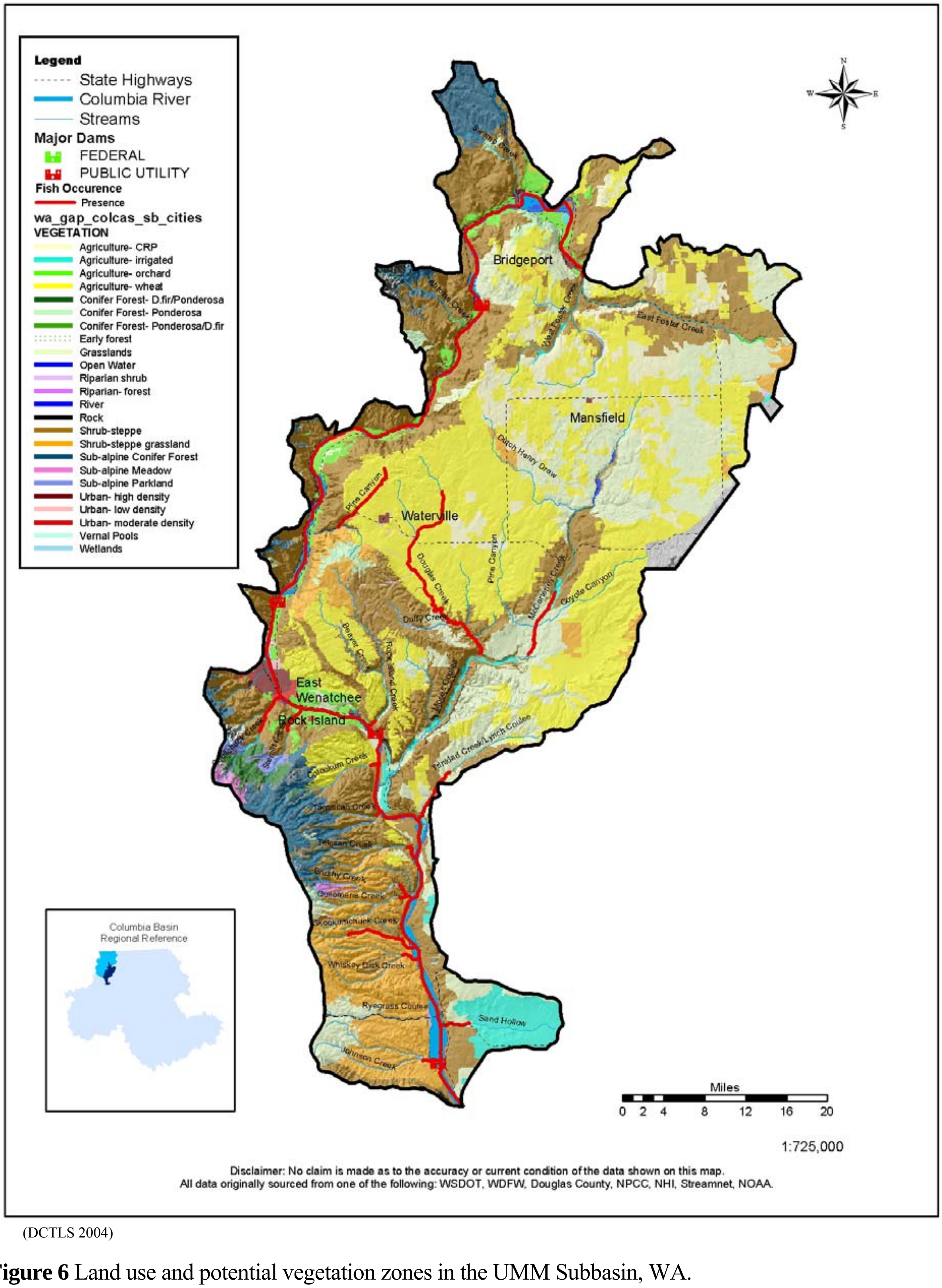
Subbasin	Federal Lands (acres)	Tribal Lands (acres)	State Lands (acres)	Local Gov't Lands (acres)	Private Lands (acres)	Water (acres)	Total (Subbasin) (acres)
Entiat	247,064	0	13,629	0	37,670	0	298,363
Lake Chelan	517,883	0	3,549	0	78,493	0	599,925
Wenatchee	682,295	0	11,836	0	159,182	0	853,313
Methow	985,234	0	55,836	0	126,724	0	1,167,794
Okanogan	400,496	311,826	261,598	0	516,159	0	1,490,079
Upper Middle Mainstem	124,492	29,507	284,996	1,216	1,167,528	0	1,607,739
Crab	303,136	0	13,629	25	2,681,363	16,100	3,014,253
Total (CCP)	3,260,600	341,333	645,073	1,241	4,767,1197,119	16,100	47,675,461,466

Please note that the IBIS ownership data is not up to date. Municipal owned land is significant in some areas and is not reflected.

3.2.3 Land Use and Demographics

Major land uses in the Subbasin include agriculture, livestock grazing, and suburban development (Figure 6). As the human population in UMM Subbasin counties grows (Figure 6 Land use and potential vegetation zones in the UMM Subbasin, WA.

Table 6), pressure on natural resources intensifies. For more information about the effects on wildlife habitat from changes in land use from circa 1850 to today, see section 3.2 (Ashley and Stovall, unpub. rpt., 2004). Two cities with populations over 10,000 residents and numerous small towns are distributed throughout the Subbasin.



(DCTLS 2004)

Figure 6 Land use and potential vegetation zones in the UMM Subbasin, WA.

Table 6 Population of UMM Subbasin counties, 1990-2020

County	1990	2000	2010 Proj.	2020 Proj.	% Increase 1990-2020	Area (sq. mi.)	2000 People/ sq. mi.	2020 People/ sq. mi.
Douglas	26,205	32,603	39,196	44,920	71.4	1,821	17.9	24.7
Chelan	52,250	66,616	75,993	85,864	64.3	2,921	22.8	29.4
Grant	54,758	74,698	88,331	95,715	74.7	2,681	27.9	35.7
Kittitas	26,725	33,362	36,742	41,776	56.3	2,297	14.5	18.2
Okanogan	33,350	39,564	44,061	47,920	43.6	5,317	7.4	9.0

U.S. Census Bureau, 1990 and 2000, Projected from Washington State Office of Financial Management website.

Urban and Rural Development

The population of Douglas County (**Table 6**) increased by 24% between 1990 and 2000 (26,205 to 32,603 people) and is expected to increase by 71.4% above 1990 figures by 2020 (26,205 to 49,920 people). This represents an increase from 14.3 people/sq. mi. in 1990 to 24.4 people/sq. mi. in 2020. Two cities within the UMM Subbasin have populations over 10,000 residents and numerous small towns are distributed throughout the Subbasin. The other counties are experiencing similar trends in population growth.

Suburban development, agriculture, and rangelands are significant land uses with the UMM Subbasin. Although urban areas comprise only 0.5 % of the UMM Subbasin, much of the urban and rural development has taken place at lower elevations along the Columbia River shoreline, between Wanapum and Chief Joseph dams, and has had significant impacts on fish and wildife habitat. As the human population continues to grow, urban sprawl and rural development will place increasing pressure on natural resources.

Agriculture

Historically, the majority of the UMM Subbasin was shrub-steppe habitat (Daubenmire 1970). Today, agricultural lands cover large portions of the UMM Subbasin. Orchards dominate the Columbia River corridor between Chief Joseph and Rock Island dams, and dryland farming and ranching are the dominant agricultural practices on the eastern plateau. Small areas of irrigated cropland are also present on the eastern side of the UMM in Moses Coulee and the Grant County portion of the subbasin.

Federal Land Management

The USFS manages land in the Entiat Ranger District, on the Wenatchee portion of the Wenatchee National Forest. The land is managed according to the Wenatchee National Forest Land and Resource Management Plan (the Forest Plan) (USDA 1990), as amended by the Northwest Forest Plan (USFS and BLM 1994a). The Forest Plan divides the land into management areas, each with a management prescription based on unique habitat conditions. The majority of National Forest land in the UMM Subbasin is managed for multiple uses, including deer and elk winter range, timber production, livestock grazing, recreation, and research.

The BLM manages 81,161 acres in the UMM Subbasin. Most of the BLM lands within the subbasin are shrubsteppe habitat. The Spokane Resource Management Plan provides the general management direction for BLM administered lands within the subbasin as required by the Federal Land Policy and Management Act of 1976. Under this act the BLM is required to manage public lands to protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use. The BLM is required by the CWA to ensure that activities on administered lands comply with requirements concerning the discharge or run-off of pollutants.

State Land Management

Two primary agencies manage land within the UMM Subbasin- WDFW and the DNR. The WDFW administers seven wildlife areas totaling 176,436 acres. This land includes owned land, and land administered through agreements with other local, state, and federal landowners. Land owned by DNR east of the Columbia River is primarily shrubsteppe used for grazing or dryland wheat cultivation. West of the Columbia River, DNR holdings are primarily managed for timber production and grazing. The primary management focus of DNR lands is to support public schools and universities by selling products like timber, grazing leases, and wheat.

Water development

Hydropower System

Five Columbia River dams are located within the UMM Subbasin: Chief Joseph, Wells, Rocky Reach, Rock Island, and Wanapum dams. All Columbia River dams, with the exception of Chief Joseph Dam, have upstream fish passage facilities and also provide downstream passage for juvenile salmonids through collection facilities or fish spill. These dams provide an economical power supply and numerous recreational and economic benefits.

Irrigation

There are four irrigation districts (Wenatchee Heights Irrigation District, Stemilt Irrigation District, the Lower Stemilt Irrigation District, and the Kennedy-Lockwood Irrigation District) and numerous private diversions operating in the Stemilt watershed (Andonaegui 2001). Other irrigation districts within the UMM Subbasin include the Palisades, (water pumped from an unconsolidated aquifer in Moses Coulee and from Douglas Creek), Bridgeport, Greater Wenatchee, and East Wenatchee. The latter three pump water from the Columbia and/or Wenatchee Rivers.

Irrigation projects have both positive and negative impacts on the small tributaries in the UMM Subbasin. Irrigation return flow from the Columbia Reclamation Irrigation Project provides increased summer flow in the Sand Hollow channel, and Trinidad Creek receives some small amounts from the same project. Sand Canyon Creek receives increased summer flow from the Wenatchee Reclamation District. An irrigation diversion structure located approximately 1.0

mile up Colockum Creek may block fish passage at low flows (B. Steele, pers. comm., 2001 in Andonaegui 2001). Two irrigation diversions are located on Douglas Creek approximately 0.25 miles from where the creek enters Moses Coulee. An irrigation dam is located on top of a natural falls at RM 1.03 on Foster Creek. It is 18 inches taller than the original falls that precluded all fish passage past this point.

Much of the Grant County portion of the UMM Subbasin is part of the Columbia Reclamation Irrigation Project and has extensive irrigated agriculture. This water originates in the Columbia River above Grand Coulee Dam and is transferred through the Banks Lake Equalization Project created by Dry Falls Dam.

Transportation

Along with hydropower and other human developments in the subbasin came the building of numerous roads and railways. Many culverts within the transportation network are barriers to fish migration and result in reduced habitat availability. Washington State Department of Transportation and FWS combined efforts to inventory state highway barriers which are now linked to the 303d Water Quality lists (Category 2). Watershed planning units have additionally sponsored, or been a part of, local inventories, such as Harza's report in Chelan County, and also assisted or lead the Limiting Factors Analysis by the Washington State Conservation Commission staff.

3.2.4 Hydrologic Conditions

Hydrography

The UMM Subbasin encompasses an estimated 1.6 million acres. The Columbia River travels about 130 miles through the subbasin. From river mile 545.1 near Chief Joseph Dam, the Columbia River flows in a westerly direction past the small communities of Bridgeport and Brewster, WA. At the eastern edge of the Cascade Mountains, the river turns and flows south to its southern boundary at river mile 415.8 by Wanapum Dam near Vantage, WA (Peven 2002).

Minor streams and Columbia River tributaries in the UMM Subbasin include: Foster, Rock Island, McCarteney and Douglas creeks (latter two drain into Moses Coulee) in Douglas County; Squilchuck, Stemilt, and Colockum creeks in Chelan County; Sand Hollow Wasteway and Trinidad Creek in Grant County; and Tekison, Brushy, Quilomene, Whiskey Dick, Tarpiscan, and Johnson creeks in Kittitas County. Jameson and Grimes Lakes are also found within this subbasin (Douglas County). Grand Coulee Equalization Reservoir (Banks Lake) and the Sun lakes border the UMM Subbasin on the east, but are not included within the boundary. The two largest watersheds located within the subbasin are the Foster Watershed Resource Inventory Area (WRIA) 50 and Moses Coulee WRIA 44. Several major tributaries —the Okanogan, Methow, Chelan, Entiat, and Wenatchee rivers—also join this reach of the Columbia River, but are not included in the UMM Subbasin (Peven 2002).

Hydrology

Hydrology in the UMM Subbasin primarily reflects a snowmelt system. Generally, snow accumulates in the surrounding mountain areas from November to March, then melts and produces peak runoff during May and June. During late summer and fall, instream flows in tributary streams often decline substantially and remain relatively low through April. Heavy rainfall in late fall or early winter can also lead to increased runoff and in the past, these rain-on-snow events in the eastern Cascades have caused some of the most significant flooding events in the subbasin (Peven 2002).

Average flow contributions from the four largest tributaries in the CCP (Okanogan, Methow, Entiat, and Wenatchee Rivers) provide 7,860 cfs to the Columbia River, while the upriver contribution from the Columbia Basin above Chief Joseph is 188,000 cfs, and the Canadian portion provides 99,200 cfs of average flow (EPA 2001).

Within the UMM Subbasin, Wanapum, Rock Island, Rocky Reach, and Wells dams impound the Columbia River. Instream flows within the UMM Subbasin are considered "run-of-river" with little storage capacity present in the reservoirs above the four hydroelectric projects. Rock Island was the first hydroelectric project to span the Columbia River and was completed in 1933. Wells Dam, which began operating in 1967, is the most recent hydroelectric project completed on the Columbia River in the subbasin (Peven 2002).

Hydroelectric operations at Grand Coulee Dam greatly influence river flows for downstream hydroelectric operations (Peven 2002). Changes in storage reservoir operations for fish passage flow augmentation, flood control and power production have resulted in reduced flows from January through April and increased flow from May through August.

Water quality

The Columbia River has been classified by Ecology as "Class A" water. On a scale ranging from Class AA (extraordinary) to Class C (fair), Class A waters are rated as excellent. State and federal regulations require that Class A waters meet or exceed certain requirements for all uses (Peven 2002).

While water quality in the UMM Subbasin is good compared to other rivers in the United States, there is still cause for concern. Primary concerns include levels of dissolved gases, changes in stream temperatures, turbidity levels and exposure to environmental contaminates above biological thresholds for fish species utilizing the river. These concerns are generally related to hydropower production, past mining practices (Canada and Spokane River are or have been major sources above the UMM Subbasin planning area), and agriculture. The hydroelectric projects on the Columbia River in the UMM Subbasin are "run-of-river" with reservoirs that have little storage capacity. Water velocities are generally fast enough to prevent the formation of a thermocline and the associated depletion of oxygen in deeper waters. Water quality parameters affected by hydropower production, include TDG, water temperature, dissolved oxygen, turbidity, suspended sediments and nutrients. The status of each of these parameters in the UMM Subbasin is summarized below (Peven 2002).

The federal Clean Water Act, adopted in 1972, requires that all states restore their waters to be "fishable and swimmable." The Clean Water Act established a process to identify and clean up polluted waters. Every two years, all states are required to prepare a list of waterbodies that do not meet water quality standards. This list is called the 303(d) list because the process is described in Section 303(d) of the Clean Water Act. The 2002-2004 Washington Department of Ecology Proposed Assessment (303d list review) shows several waterbodies have impaired water quality. A summary of some waterbodies in the UMM Subbasin is listed in Table 7 for Category 5 (requires a TMDL) and Category 2, waters of concern. For details please refer to the WDOE website: http://www.ecy.wa.gov/. Not listed is Foster Creek, which, according to Foster Creek Conservation District data 2000-2003, has peak summer temperatures that exceed the standard (FCCD, unpublished monitoring data, 2003).

Table 7 Water quality parameters for some waterbodies in the UMM Subbasin, WA.

Water body	Parameter	WRIA (40,41,44,50)	Category
Columbia River	Temperature	40, 41, 44, 50	5
	Total Dissolved Gas	40, 41, 44, 50	5
	Temperature	50	2
	Total Dissolved Gas	44, 50	2
	pH	40, 41	2
	Dissolved Oxygen	41	2
	3,3-Dichlorobenzidine	40	2
	Benzo(a)pyrene	40	2
	Heptachlor	40	2
	Mercury	40	2
Grimes Lake	Total Phosphorus	44	2
Jameson Lake	Total Phosphorus	44	2
Black Lake	Total Phosphorus	40	2
Sand Hollow Wasteway	pH	41	5
	Temperature	41	5

(WDOE 2004)

Grant County PUD (2003a) measured physical parameters to describe Columbia River water quality attributes as a portion of their relicensing application. This provides a way to compare and track seasonal and historical trends in water quality status. These parameters also form the basis for comparison with water quality standards. Key physical parameters include temperature, TDG concentrations, DO concentrations, acidity (pH), and turbidity. Other physical parameters commonly collected from reservoirs are conductivity, alkalinity, and light attenuation measurements. More detailed information on these parameters is provided in Normandeau et al. (2000) and Juul (2003).

Grant PUD performed detailed comparisons of available water quality data with criteria for state standards. Juul (2003) compared TDG, pH and turbidity to binomial distribution exceedence limits described in Ecology Policy 1-11. This comparison showed that TDG failed to meet the binomial distribution limits, but pH and turbidity were well within the binomial distribution limits for all data analyzed. However, as noted earlier, one must understand that MCCC representatives attempt to maximize spill levels and manage for compliance with the 120% tailrace criteria while tending to de-emphasize the 115% forebay criteria.

Ecology uses different comparison methods for fecal coliform bacteria, but all samples were well below the standard. In addition, nearly all DO measurements were above 8 mg/L with only two historical measurements of 7.6 mg/L and 7.5 mg/L taken in 1969 and 1987, respectively. The remaining 457 measurements were all above 8.0 mg/L (Normandeau Associates 2003).

Comparisons of temperature data to standards are much more complex, because the standards contain both special conditions and exceptions for situations where natural conditions already exceed the standard. The 20°C special condition below Priest Rapids Dam allowed for straightforward comparisons. From 1999 through 2001, over 22,000 hourly temperature measurements below Priest Rapids Dam contained not one hourly measurement greater than 20°C; showing remarkable compliance with the special condition standard. During warmer weather in 1995 and 1998, 12-13% of hourly measurements were in excess of 20°C, with maximum measurements being about 1°C above the 20°C special condition (Normandeau Associates 2003). However, naturally warm water conditions are not considered violations of water quality standards.

Comparisons to the 18°C are not as simple because the policy guidance and temperature standard considers natural conditions. To estimate natural conditions, Juul (2003) used historical data from Rock Island Dam during the 1933-41 time period when it was the only Columbia River dam and its very limited storage and low height would have minimal effects on temperature. Review of this data showed that high percentages of temperature readings were greater than 18°C with some July through September periods showing nearly 100% of temperature measurements greater than the present-day standard. While large percentages of available data (Normandeau Associates 2003) are greater than the 18°C criteria, because of the natural conditions, these values are not considered violations of water quality standards.

Water uses

Flows in the Columbia River are regulated and managed to provide for hydropower production, flood control, fish passage, irrigation, and other uses. Instream flows for the Columbia River were first established in 1980 under the Instream Resources Protection Program (codified in Chapter 173-563 WAC). From 1980 to 1997, any water rights issued were made subject to interruption should Columbia River Instream Flows not be met. In response to the federal protection of salmonids in the Columbia and Snake River Systems through Endangered Species Act listings in December of 1991, in the spring of 1992 Ecology issued an order placing a moratorium on further allocation of water from the Columbia River. Legislative action in 1997 eliminated Columbia River instream flows and moratorium for all future water resource decisions. However, streamflow monitoring continues for the management of hundreds of water use authorizations with priority dates between 1980 and 1997. In water year 2001, enforcement and other management actions were taken by Ecology as, for the first time, instream flows were not met. Monitoring and management of streamflow will continue as these water rights will continue to be subject to the 1980 instream flows (Peven 2002).

3.3 Guiding Principles

The Guiding Principles are sets of statements to clarify the scope, analysis, and limitations of this document. In addition, there are two visions: one is that of the NPCC and the other was developed through local planning processes and adapted for this Subbasin Plan. The Guiding Principles are divided into three major parts: Vision, planning assumptions, and foundation principles.

3.3.1 Vision

As quoted from NPCC's Columbia Basin Fish and Wildlife Program (2000), the overall vision for the NPCC Fish and Wildlife program is:

> The vision for this program is a Columbia River ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife, mitigating across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem and providing the benefits from fish and wildlife valued by the people of the region. This ecosystem provides abundant opportunities for tribal trust and treaty right harvest and for non-tribal harvest and the conditions that allow for the recovery of the fish and wildlife affected by the operation of the hydrosystem and listed under the Endangered Species Act.
>
> Wherever feasible, this program will be accomplished by protecting and restoring the natural ecological functions, habitats, and biological diversity of the Columbia River Basin. In those places where this is not feasible, other methods that are compatible with naturally reproducing fish and wildlife populations will be used. Where impacts have irrevocably changed the ecosystem, the program will protect and enhance the habitat and species assemblages compatible with the altered ecosystem. Actions taken under this program must be cost-effective and consistent with an adequate, efficient, economical and reliable electrical power supply.

Consistent with the 2000 Columbia Basin Fish and Wildlife Program's vision, yet tailored specifically to the geographic region of the UMM Subbasin and its citizenry. The Vision Statement for the subbasin is largely based on the Douglas County Watershed Planning Association Goal Statements for water resources. They are based on a sustainable future for the landscape, the economy, and the people within the UMM Subbasin.

Our vision for the landscape is to balance habitat conservation with human uses to ensure the long-term health of plant, fish, wildlife and human communities.

Our vision for the economy is based on efficient management and use of natural resources including reliable water supplies, fish and wildlife populations, and aquatic and terrestrial habitats.

Our vision for the people is to manage natural resources to promote social and economic well-being and to improve or maintain our quality of life. We will work together to foster increased understanding of the importance of natural resource conservation.

The vision and subbasin plan is the outcome of an open process and is intended to provide a framework under which future projects can be developed and implemented. Actions taken in the subbasin should be consistent with the UMM Subbasin Plan (Subbasin Plan) the NPCC Columbia Basin Fish and Wildlife Program, the CWA, and the ESA.

3.3.2 Planning Assumptions

As a part of this vision, the Subbasin Plan adopts the following policy judgments and planning assumptions:

- The ultimate success of the projects, processes, and programs used to implement the Subbasin Plan will require a cooperative and collaborative approach that balances federal and state mandates to protect fish and wildlife with economies, customs, cultures, subsistence, and recreational opportunities within the basin.
- The Subbasin Plan is not a land use management plan and contains no regulatory authority.
- *No single activity is sufficient to recover and rebuild fish and wildlife species in the UMM Subbasin or in the Columbia River Basin. Successful protection, mitigation, and recovery efforts must involve a broad range of strategies for habitat protection and improvement, as well as improvements to the operations of the hydrosystem, effective and equitable harvest management, and the continued incorporation of artificial production.
- *The BPA should make available sufficient funds to implement projects developed within the framework provided by this plan in a timely fashion.
- *This is a habitat-based program, for rebuilding healthy, naturally producing fish and wildlife populations by protecting, mitigating, and restoring habitats. Artificial production and other non-natural interventions should be consistent with the central effort to protect and restore habitat and avoid adverse impacts on native fish and wildlife species.
- *It is important to consider out-of-basin effects on fish and wildlife populations.
- *There is an obligation to provide fish and wildlife mitigation where habitat has been permanently lost because of hydroelectric development. Artificial production of fish may be used to replace capacity, bolster productivity, and alleviate harvest pressure on weak, naturally spawning resident and anadromous fish populations. Restoration of anadromous fish into areas blocked by dams should be actively pursued where feasible.
- *Management actions, including artificial production, must have an experimental, adaptive management design. This design will allow managers to evaluate benefits of management actions and address scientific uncertainties.
- *Salmon harvest can provide significant cultural, recreational, and economic benefits to the region. Harvest rates should be based on population-specific adult escapement objectives designed to protect and recover naturally spawning populations.
- *Achieving the vision requires that habitat management, artificial production, harvest, and hydrosystem operation are coordinated at the subbasin, CCP, and basin levels, including actions not funded by this program.
- Implementation of subbasin plans should include participation stakeholders at the subbasin and regional level.

* Adapted from and consistent with the NPCC's 2000 Columbia Basin NPCC Fish and Wildlife Program.

These specific planning assumptions are to be incorporated into projects developed within the framework provided by this Subbasin Plan. Actions taken in the UMM Subbasin should be consistent with these planning assumptions.

3.3.3 Foundation Principles

These foundation principles reflect the natural and cultural systems in the UMM Subbasin and are based on the following items:

- Economies, customs, cultures, subsistence and recreational opportunities within the basin
- Regulation of land use
- Out of basin effects
- Long term sustainability
- Fish and wildlife habitat
- Connectivity

Foundation Principle 1: Economies, customs, cultures, subsistence and recreational opportunities within the basin

The people of the UMM Subbasin are diverse and independent. They value a wide range of customs and cultures. Actions, strategies, programs, and projects for fish and wildlife and their habitats will be more successful if developed in context with the basin's economic needs and opportunities, and with an understanding of the impacts on the human environment in the basin

Supporting Principles:

- Activities associated with the Subbasin Plan, undertaken to protect and/or restore fish and wildlife, have the potential to improve opportunities for cultural and recreational uses and thus, social and economic well-being of the communities. Strategies and projects should be reviewed and evaluated based on the potential for such positive impacts, and methods developed to measure and monitor the success of such efforts.
- Costs and benefits of implementing Subbasin Plan actions should be weighed. Alternatives that achieve the greatest benefits at the least costs are preferred.
- Subbasin Plan actions are undertaken with the understanding that fish and wildlife resources and their habitat are a cultural heritage common to the people of the UMM Subbasin, and such actions play a key role in the long-term sustainability of the environment. Projects implemented based on the Subbasin Plan will be consistent with federal tribal trust responsibilities.
- Recreational opportunities are provided for diverse user groups, consistent with conservation and enhancement of subbasin resources.
- Programs and projects are monitored and evaluated for effectiveness and may be altered as necessary to achieve the intended results.

Foundation Principle 2: Regulation of land use

Protection and/or restoration strategies that affect land use will require action (both for the adoption and implementation) by local, state, federal and/or tribal governments, and close, coordinated relationships among these groups.

Supporting Principles:

- No existing water right is affected by actions derived from the Subbasin Plan without the consent of the holder of that right.
- The processes of subbasin plan preparation, implementation (including project development and planning), and amendment are open, voluntary, and collaborative.
- Subbasin Plan actions acknowledge the statutory authority of local, state, federal, and tribal governments and existing plans, programs, and processes.
- Future land use planning and activities that involve potential impacts on fish and wildlife and their habitats should be fully discussed with agencies and tribes with management authority prior to implementation.

Foundation Principle 3: Out of basin effects

The Columbia River Basin is characterized by natural environmental variability and established human urban and rural activities. Restoration and management of fish and wildlife and their habitats in the UMM Subbasin must consider effects within the entire Columbia River Basin ecosystem.

Supporting Principles:

- Strategies for recovery or maintenance of self-sustaining populations need to be evaluated within the context of the entire life history of the populations, not just within the life history stages within the UMM Subbasin.
- Important environmental attributes that determine the distribution and productivity of fish and wildlife populations have been influenced by natural and anthropogenic activities in and outside the subbasin.

Foundation Principle 4: Long-term sustainability

Fish and wildlife adapt to their habitat through life history characteristics, genetic diversity, and metapopulation organization. They adapt to spatial and temporal environmental variations through diversity and population structure. Diversity promotes production and long-term persistence at the species level.

Supporting Principles

- In addition to fish and wildlife populations that support the custom, culture, subsistence and recreational opportunities in the subbasin, indigenous fish and wildlife species should be enhanced and restored to be self-sustaining.
- Selection of a broad range of fish and wildlife focal species provides a basis for developing holistic management strategies.

- Biological inter- and intra-specific interactions shape fish and wildlife populations. Restoration of individual populations may not be possible without restoring other fish and wildlife populations with which they co-evolved.
- Most native fish and wildlife populations are linked across large areas and do not consider political borders. An important component for recovery of depressed populations is to maintain or re-create large-scale spatial diversity.
- Populations with the least amount of change from their historic spatial diversity are the easiest to protect and maintain.
- Small populations are at greater risk of extinction than large populations, primarily because they are more vulnerable to environmental changes and catastrophic events.

Foundation Principle 5: Fish and wildlife habitat

Fish and wildlife productivity requires a network of interconnected habitats that are created, altered, or maintained by both natural and human processes in terrestrial, freshwater, estuary, and ocean areas.

Supporting Principles:

- The habitat in the UMM Subbasin should be capable of supporting self-sustaining, harvestable, and diverse populations of fish and wildlife.
- The UMM Subbasin is a dynamic system that will continue to change through natural events and human activities.

Foundation Principle 6: Biological Interactions and Connectivity

Ecosystem attributes affect population, abundance, and diversity of the biotic community. Connectivity among ecosystem attributes is required for assemblages of species that share requirements for similar ecosystem habitat attributes.

Supporting Principles:

- Fish and wildlife are dependent upon properly functioning environments, and the processes that sustain them, to maintain sustainable, harvestable, and diverse populations.
- Native fish and wildlife populations have been negatively impacted by changes to the physical characteristics and connectivity of their habitats within the UMM Subbasin. It is critical to reconnect the native ranges of fish and wildlife species.

4 Assessment

The assessment for the UMM Subbasin consists of terrestrial/wildlife and aquatic/fish sections that were analyzed using different methodologies and processes. Wildlife was assessed using two primary sources of information: IBIS and Washington GAP analysis. WDFW staff assembled and reviewed that data and compiled species information from numerous sources to develop the course level assessment. Fish species were analyzed for two different hydrologic systems; the mainstem Columbia River and the small tributaries. The mainstem was primarily examined through existing documents for HCPs and FERC licensing from the three public utility districts in Chelan, Douglas, and Grant Counties. No suitable modeling processes were found to be useable on the subbasin scale for the Columbia River. The tributaries were assessed using existing documents, such as limiting factors analysis, watershed planning unit (2514) produced documents, and other state and federal agency documents. Information was also provided by the GCPUD to assist with the assessment. In addition, WDFW staff field examined several tributaries where little or no information exists. All of these sources were used to complete a Qualitative Habitat Assessment for the small tributaries. Ecosystem, Diagnosis and Treatment (EDT) was not deemed appropriate for the small tributaries given the limited amount of information, limited fish use, and/or size of watersheds. Details of both of the processes are decribed below and were used for development of the management plan objectives and strategies.

4.1 Focal Species

4.1.1 Introduction

A total of 391 fish and wildlife species are likely to inhabit the UMM Subbasin (Tables 2 - 4, Appendix B). Eight wildlife and two fish species were chosen as focal species to represent three focal wildlife and four focal aquatic habitats within the UMM Subbasin. Habitat attributes required by the focal species represent conditions and features of a properly functioning ecosystem and desired future conditions for focal habitats that will direct planners in developing and implementing habitat management goals and activities for the UMM Subbasin.

4.1.2 Focal Species Selection and Rationale

Lambeck (1997) defined focal species as a suite of species whose requirements for persistence define the habitat attributes that must be present if a landscape is to meet the requirements for all species that occur there (Figure 7). The key characteristic of a focal species is that its status and trend provide insights to the integrity of the larger ecological system to which it belongs (USFS 2000).

Subbasin planners refer to these species as “focal species” because they are the focus for describing desired habitat conditions and attributes and needed management strategies and/or actions. The rationale for using focal species is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the CCP also impact wildlife species, hence, the decision by subbasin planners to focus on focal habitats with focal species in a supporting role (Ashley and Stovall, unpub. rpt., 2004).

CCP planners consider focal species' life requirements representative of habitat conditions or features that are important within a properly functioning focal habitat type. In some instances, extirpated or nearly extirpated species (e.g., sharp-tailed grouse) were included as focal species if subbasin planners believed they could potentially be reestablished and/or are highly indicative of some desirable habitat condition (Ashley and Stovall, unpub. rpt., 2004).

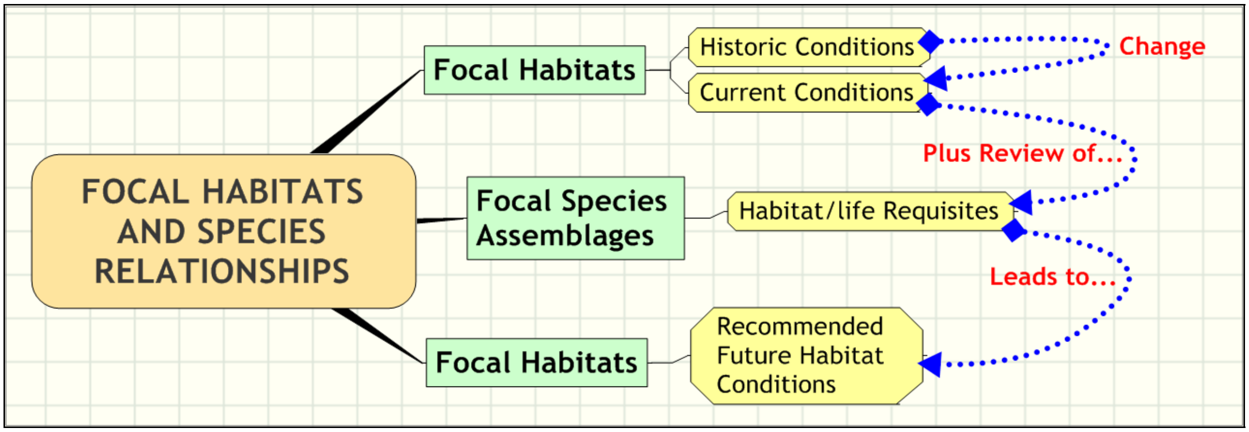


Figure 7 Focal habitats and species assemblage relationships

Terrestrial / Wildlife

There are an estimated 349 wildlife species that likely occur in the UMM Subbasin (Tables 2 and 3, Appendix B). Of these species, 111 (31%) are closely associated with riparian and wetland habitat and 74 (21%) consume salmonids during some portion of their life cycle (Table 8). Three wildlife species that occur in the Subbasin are listed federally and 30 species are listed in Washington as Threatened, Endangered, or Candidate species (Table 5, Appendix B). A total of 98 bird species are listed as Washington or Idaho State Partners in Flight priority and focal species (Table 6, Appendix B). A total of 50 wildlife species are managed as game species in Washington (Table 7, Appendix B). Species richness and associations for the UMM Subbasin are described in Table **8**).

For wildlife and terrestrial habitat resources, CCP/Subbasin planners identified a focal species assemblage (i.e., species that inhabit the same habitat type and require similar habitat attributes) for each focal habitat type (Table 9). Six bird species and two mammalian species were selected to represent three focal habitats (Shrubsteppe, Eastside [Interior] Riparian Wetland, and Herbaceous Wetland) in the UMM Subbasin: pygmy rabbit, sage grouse (*Centrocercus urophasianus*), sage thrasher (*Oreoscoptes montanus*), sharp-tailed grouse (*Tympanuchus phasianellus*), willow flycatcher (*Empidonax traillii*), beaver (*Castor canadensis*), Lewis' woodpecker (*Melanerpes lewis*), and red-winged blackbird (*Agelaius phoeniceus*).

Table 8 Species richness and associations for the UMM Subbasin, WA.

Class	Upper Middle Mainstem	% of Total	Total (CCP)
Amphibians	15	88	17
Birds	230	98	234
Mammals	86	89	97

Class	Upper Middle Mainstem	% of Total	Total (CCP)
Reptiles	18	95	19
Total Species	**349**	**95**	**367**
Association			
Riparian Wetlands	75	96	78
Other Wetlands (Herbaceous and Montane Coniferous)	36	95	38
All Wetlands	111	96	116
Consume Salmonids	74	90	82

(IBIS 2003)

Table 9 Focal species selection matrix for the CCP, WA.

Common Name	Focal Habitat1	Status2		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
Sage thrasher	SS	n/a	C	Yes	Yes	Yes	No
Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
Grasshopper sparrow		n/a	n/a	Yes	No	Yes	No
Sharp-tailed grouse		SC	T	Yes	Yes	Yes	No
Sage grouse		C	T	Yes	Yes	No	No
Pygmy rabbit		E	E	Yes	Yes	No	No
Mule deer		n/a	n/a	Yes	Yes	No	Yes
Willow flycatcher	RW	SC	n/a	Yes	No	Yes	No
Lewis woodpecker		n/a	C	Yes	Yes	Yes	No
Red-eyed vireo		n/a	n/a	Yes	No	No	No
Yellow-breasted chat		n/a	n/a	Yes	No	No	No
American beaver		n/a	n/a	Yes	No	No	Yes
Pygmy nuthatch	PP	n/a	n/a	Yes	No	No	No
Gray flycatcher		n/a	n/a	Yes	No	No	No
White-headed woodpecker		n/a	C	Yes	Yes	Yes	No
Flammulated owl		n/a	C	Yes	Yes	Yes	No
Red-winged blackbird	HW	n/a	n/a	Yes	No	No	No

Common Name	Focal Habitat1	Status2		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				
1 SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine; HW = Herbaceous Wetlands 2 C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered							

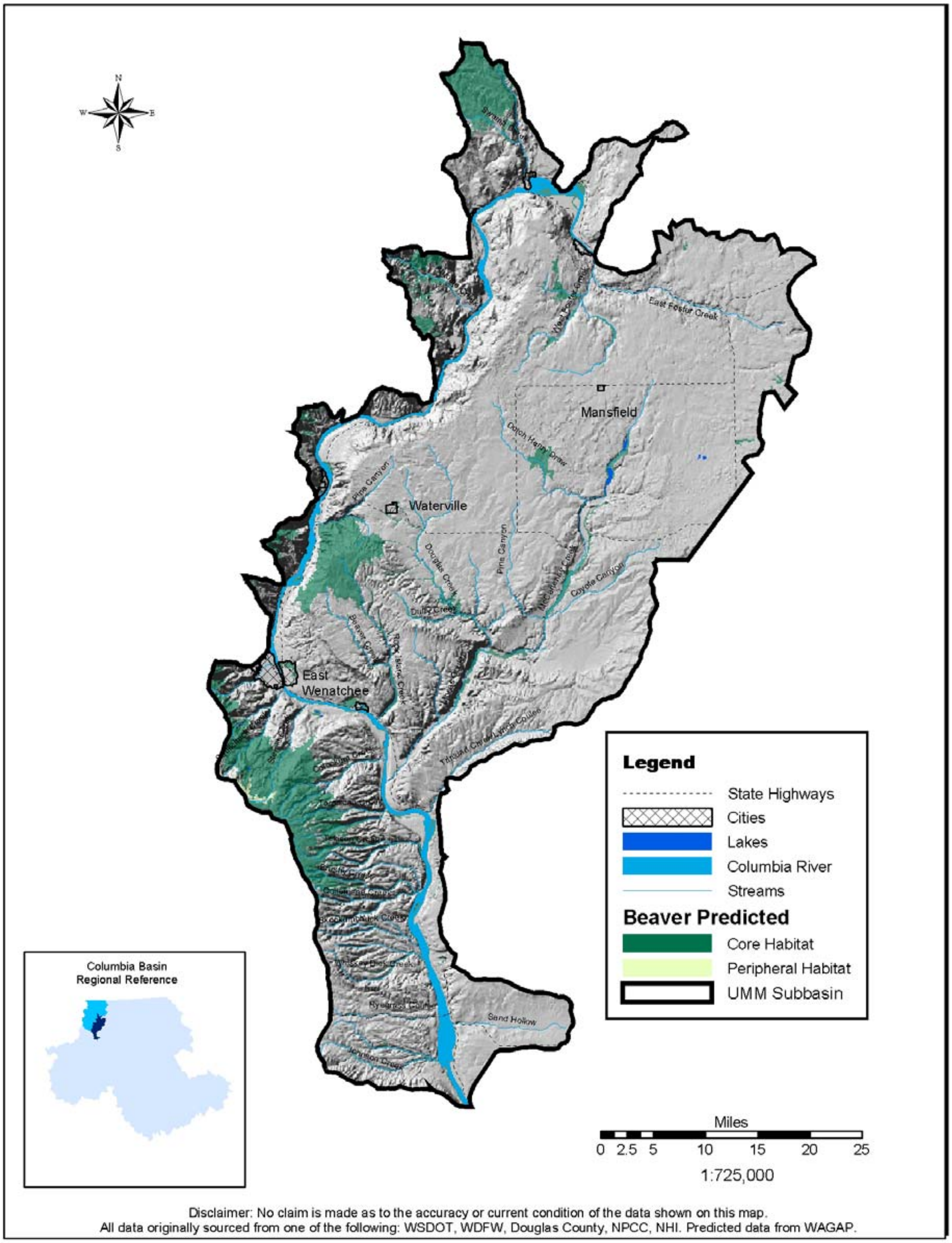
(Ashley and Stovall, unpub. rpt., 2004)

Life requisite habitat attributes for each species assemblage were then pooled to characterize a "range of management conditions", to guide planners in development of future habitat management strategies, goals, and objectives (Ashley and Stovall, unpub. rpt., 2004). Establishing habitat conditions favorable to focal species will benefit a wider group of species with similar habitat requirements. Wildlife species associated with focal habitats including agriculture are listed in Table 2 (Appendix B).

Life History of Wildlife Focal Species

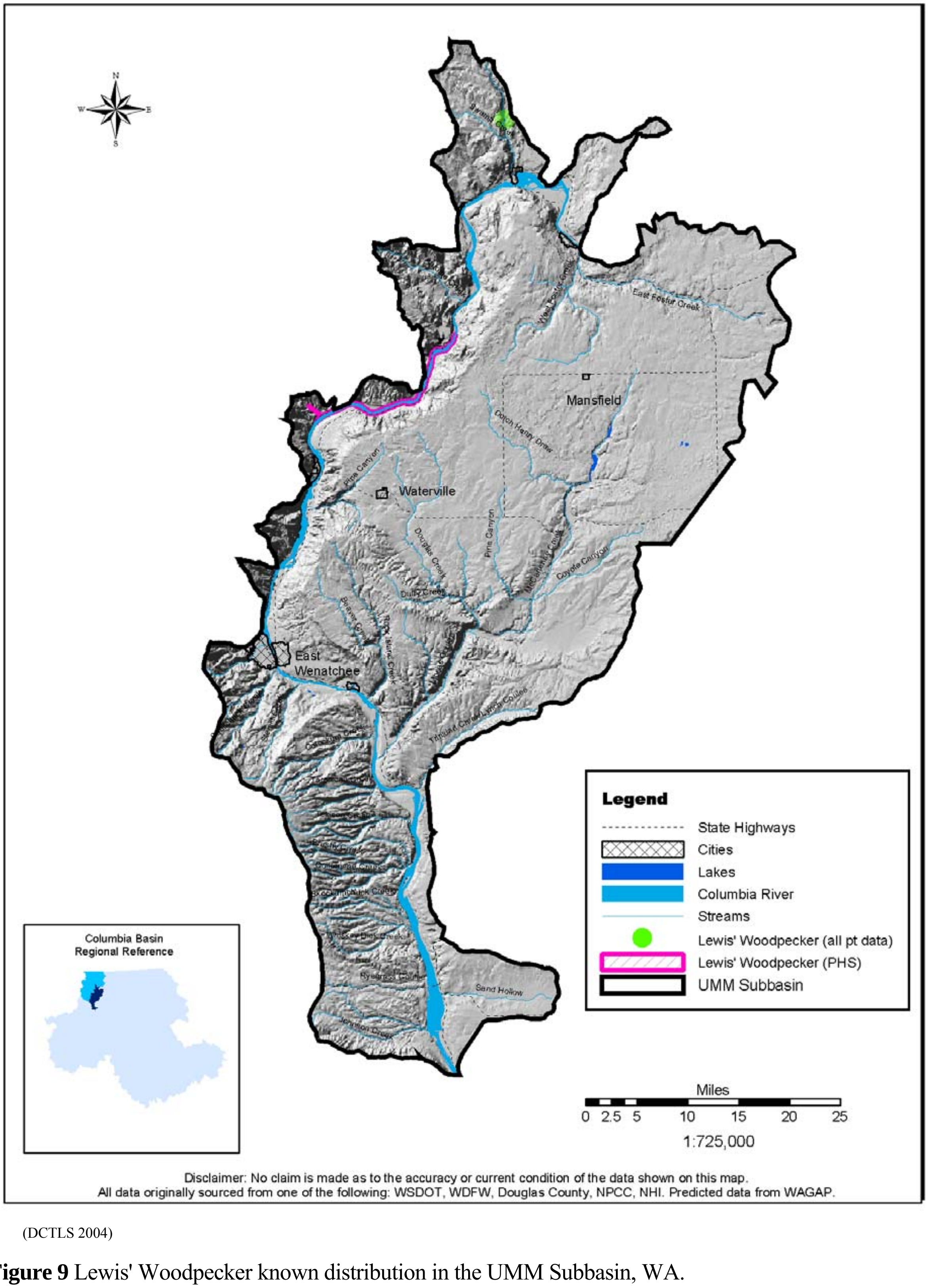
General habitat requirements, limiting factors, distribution, population trends, and analyses of structural conditions, key ecological functions, and key ecological correlates for individual focal species except red-winged blackbird are included in Ashley and Stovall (unpub. rpt., 2004). Red-winged blackbird information is in Appendix C . Figure 8 to Figure 17 Sharp-tailed grouse predicted distribution in the UMM Subbasin, WA.

below depict the distribution of focal wildlife species in the UMM Subbasin. The reader is encouraged to review additional focal species life history information in Appendix F in Ashley and Stovall (unpub. rpt., 2004).



(DCTLS 2004)

Figure 8 American beaver predicted distribution in the UMM Subbasin, WA.



(DCTLS 2004)

Figure 9 Lewis' Woodpecker known distribution in the UMM Subbasin, WA.

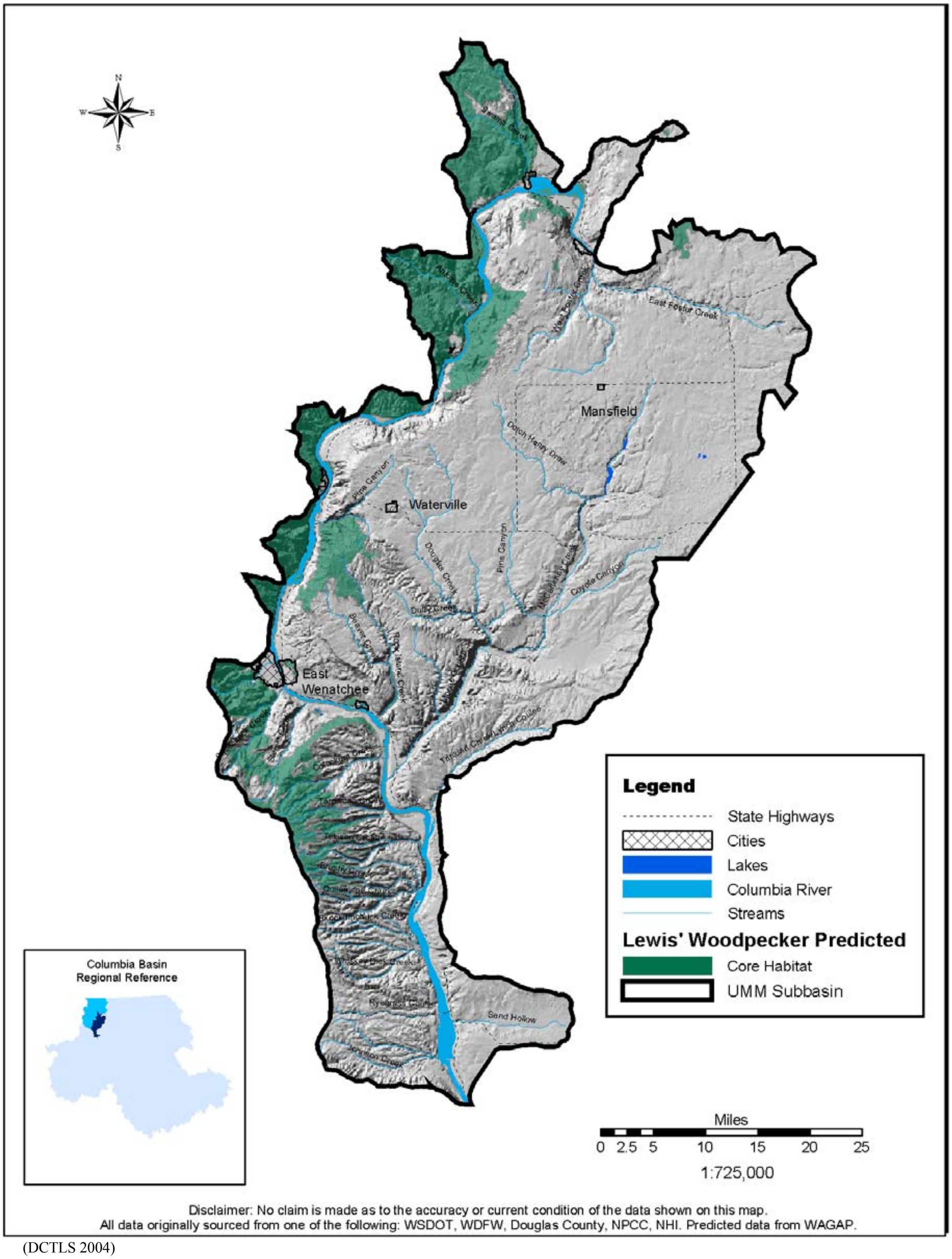


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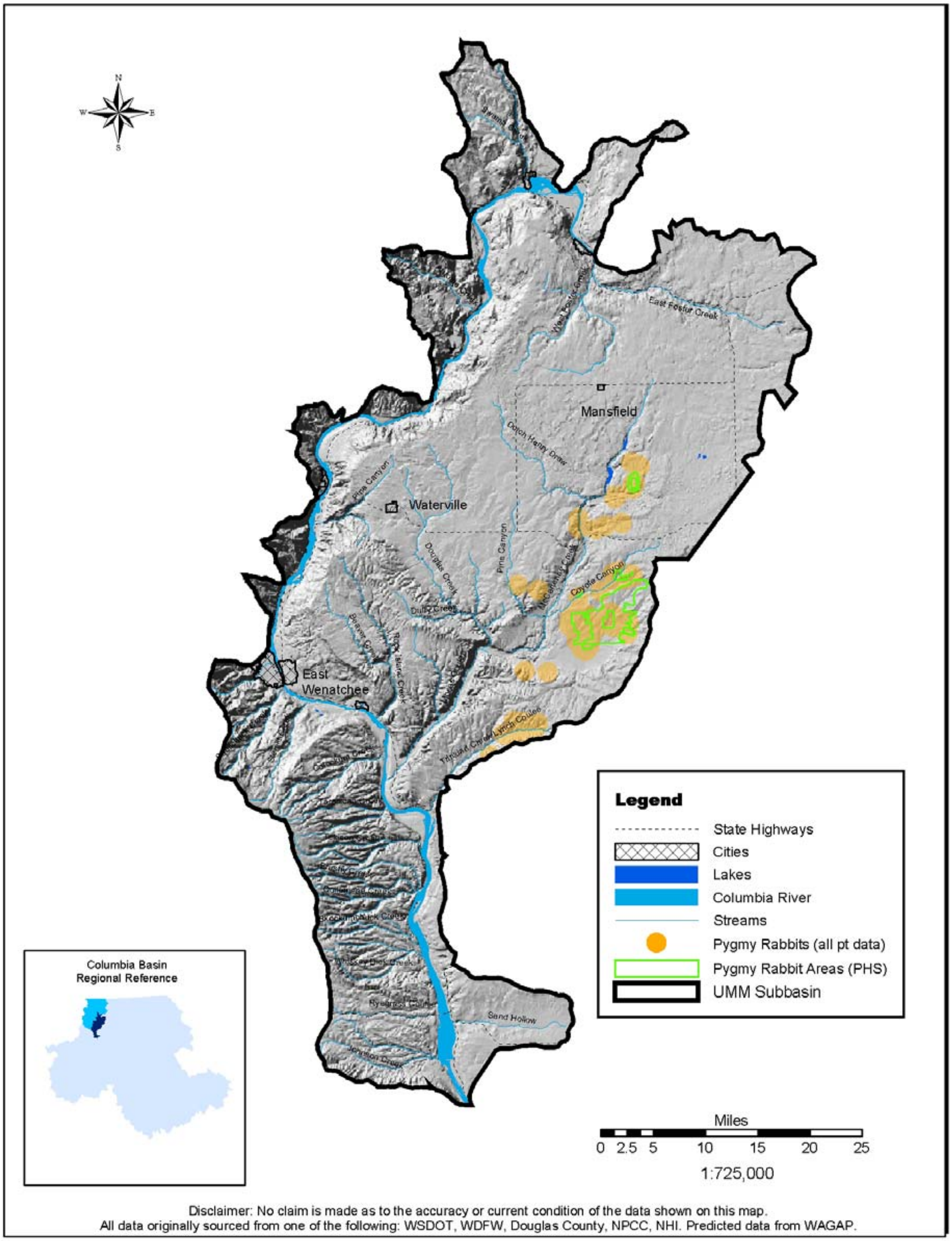
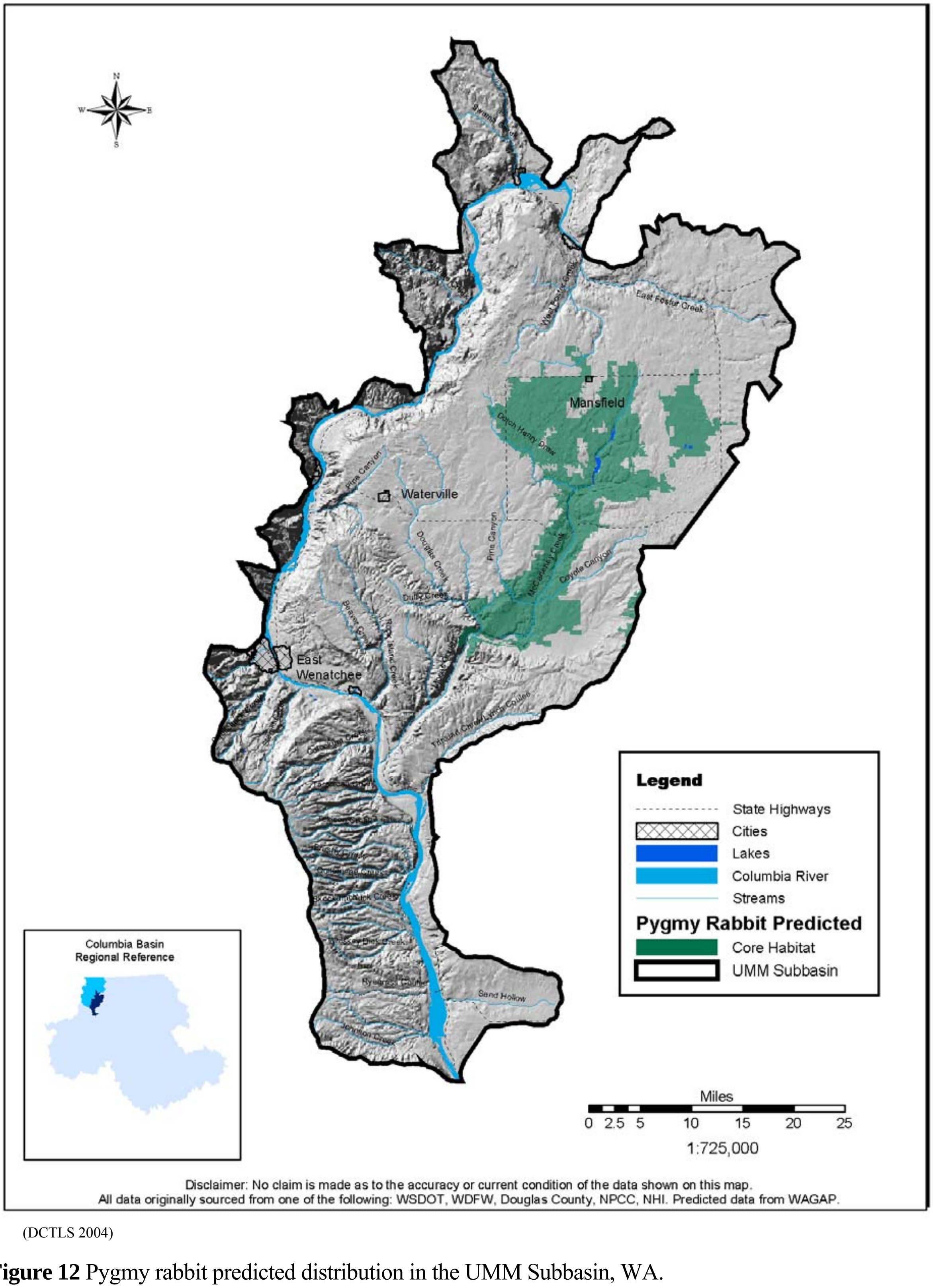
Figure 10 Lewis' woodpecker predicted distribution in the UMM Subbasin, WA.



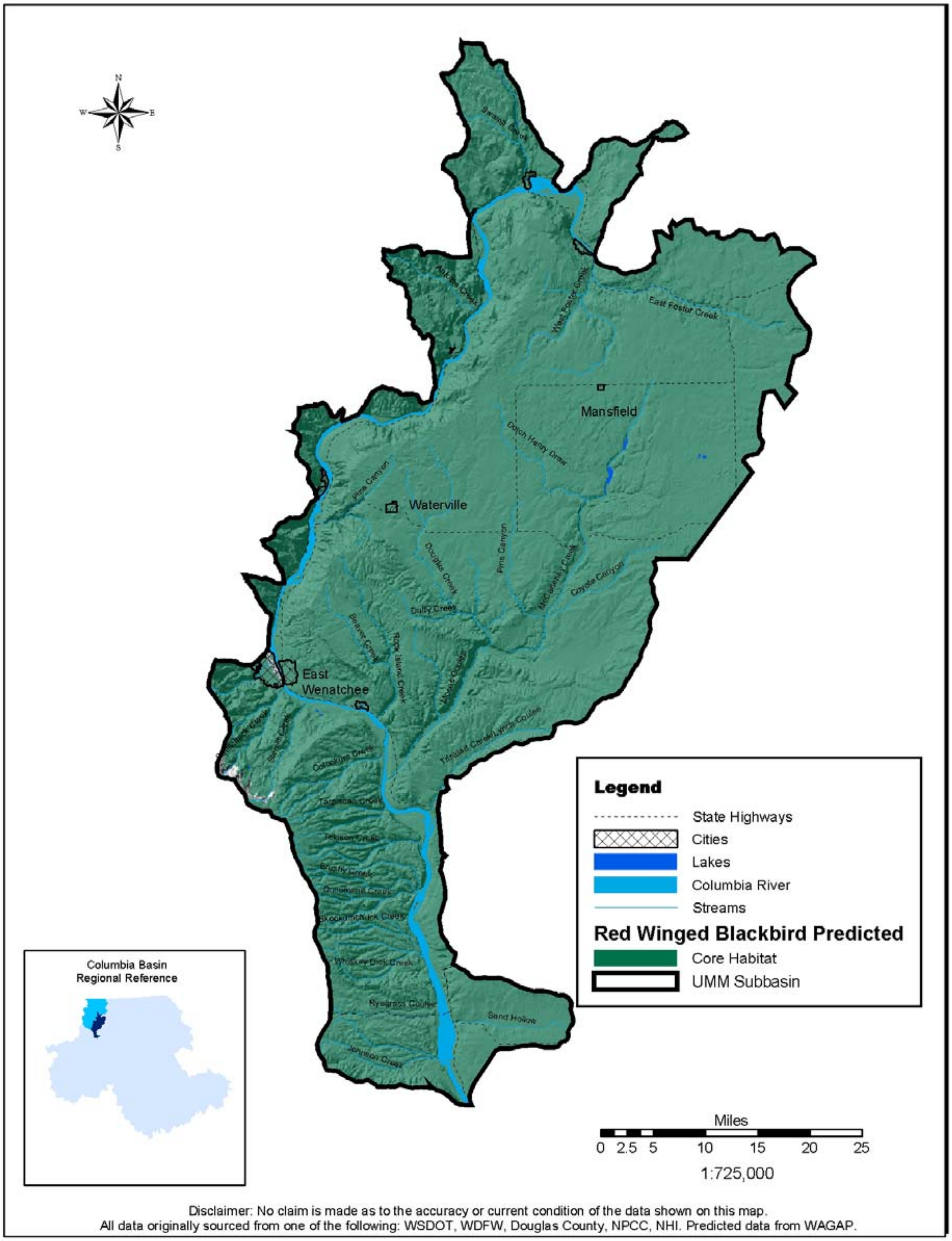
(DCTLS 2004)

Figure 11 Pygmy rabbit known distribution in the UMM Subbasin, WA.



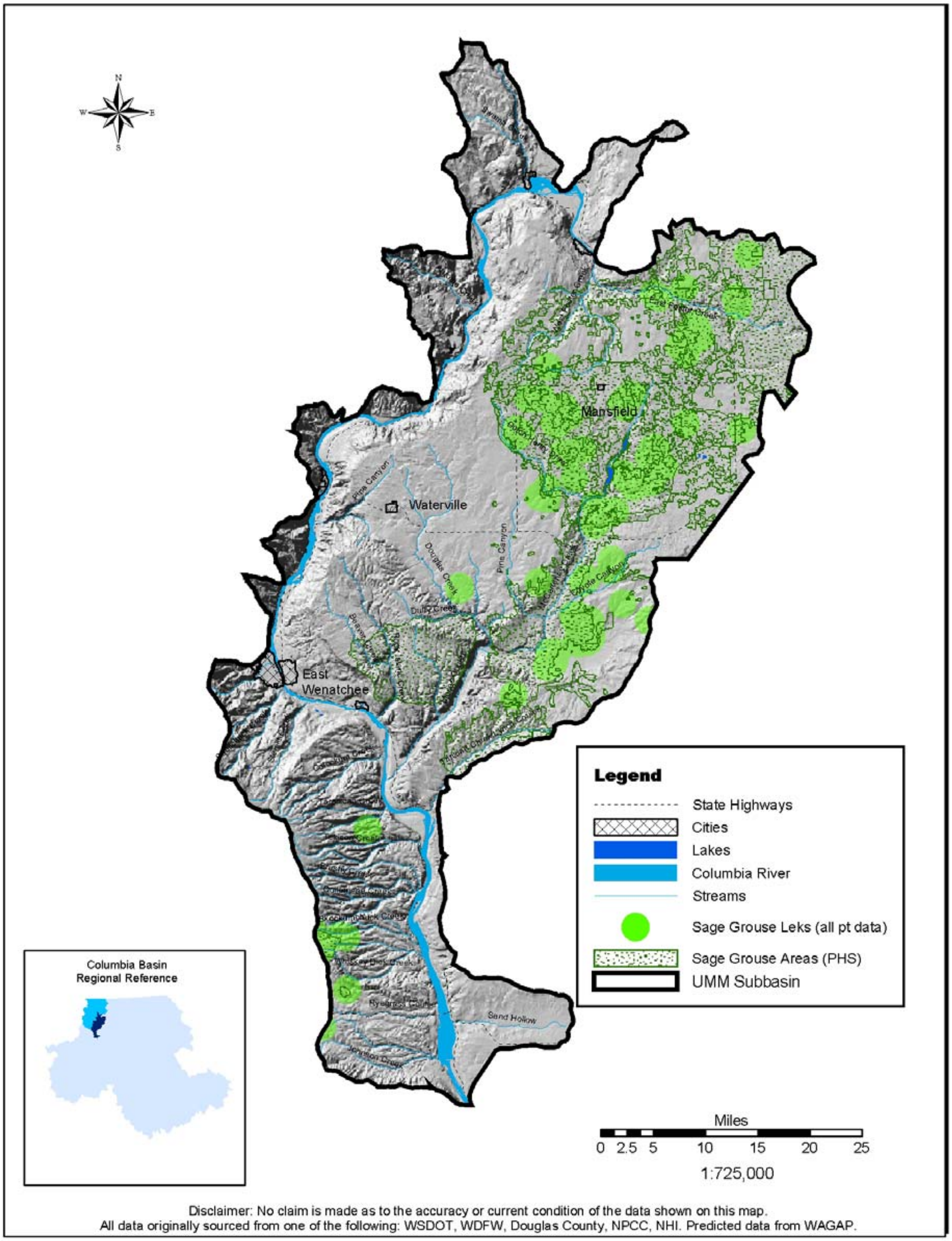
(DCTLS 2004)

Figure 12 Pygmy rabbit predicted distribution in the UMM Subbasin, WA.



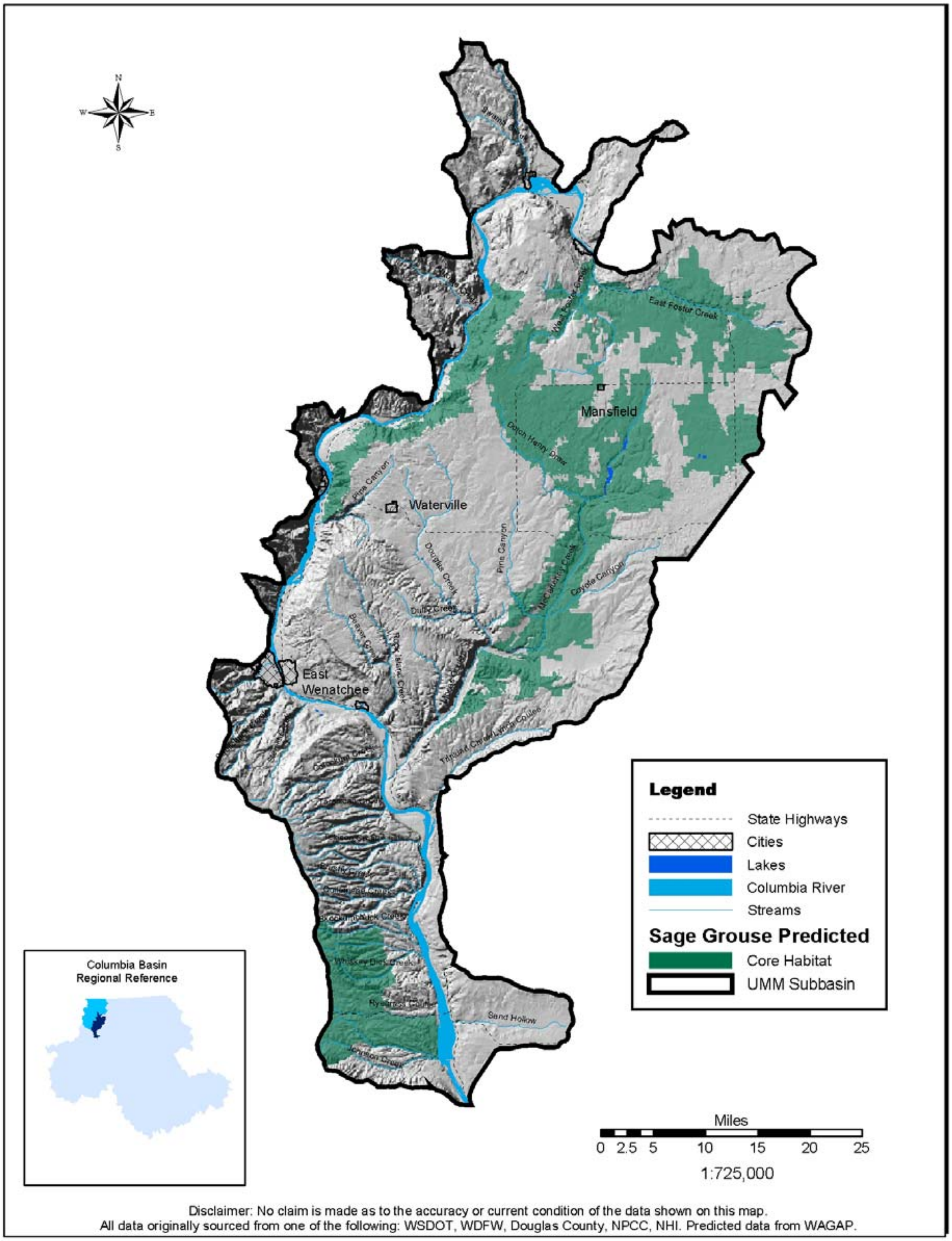
(DCTLS 2004)

Figure 13 Red-winged blackbird predicted distribution in the UMM Subbasin, WA.



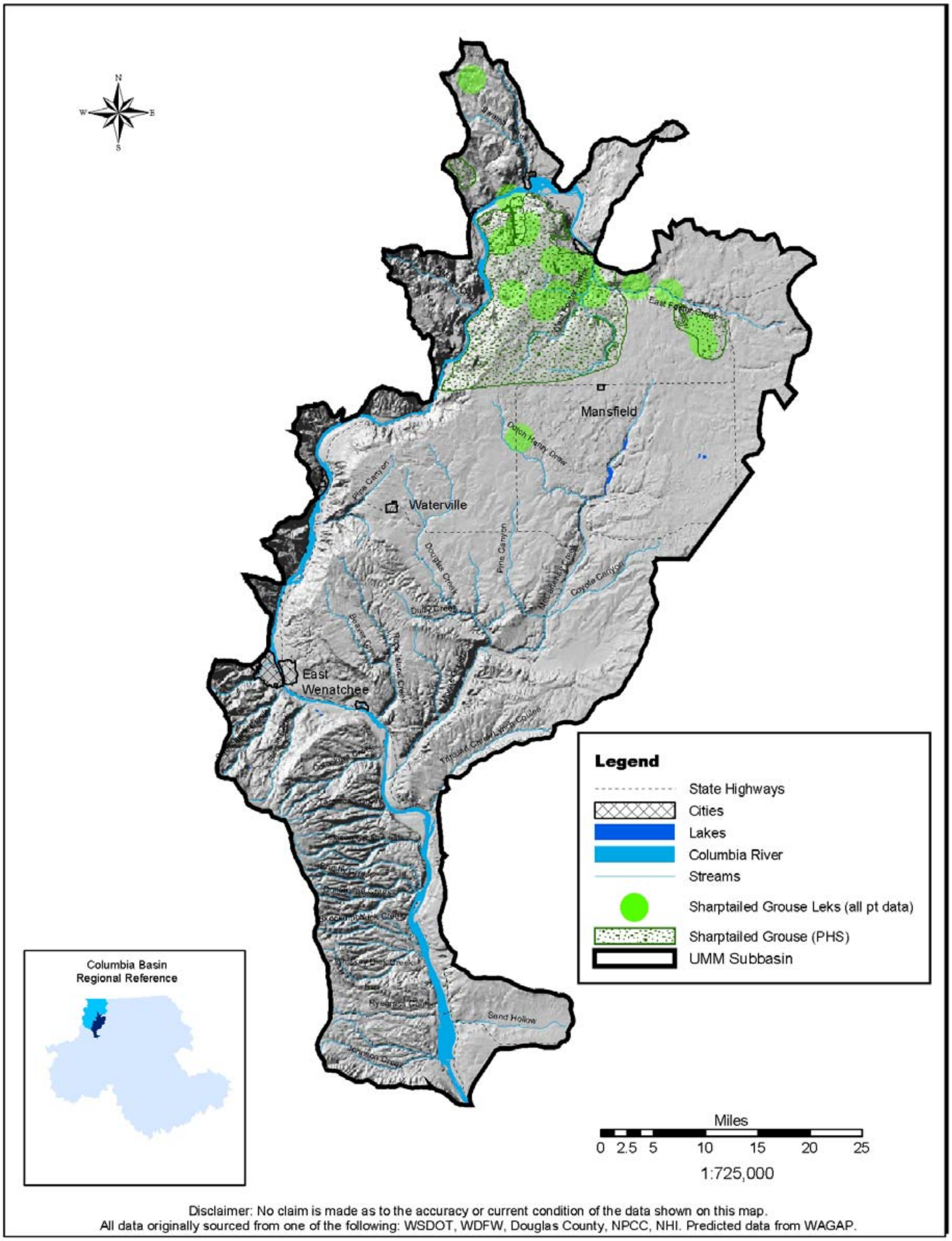
(DCTLS 2004)

Figure 14 Sage grouse known distribution in the UMM Subbasin, WA.



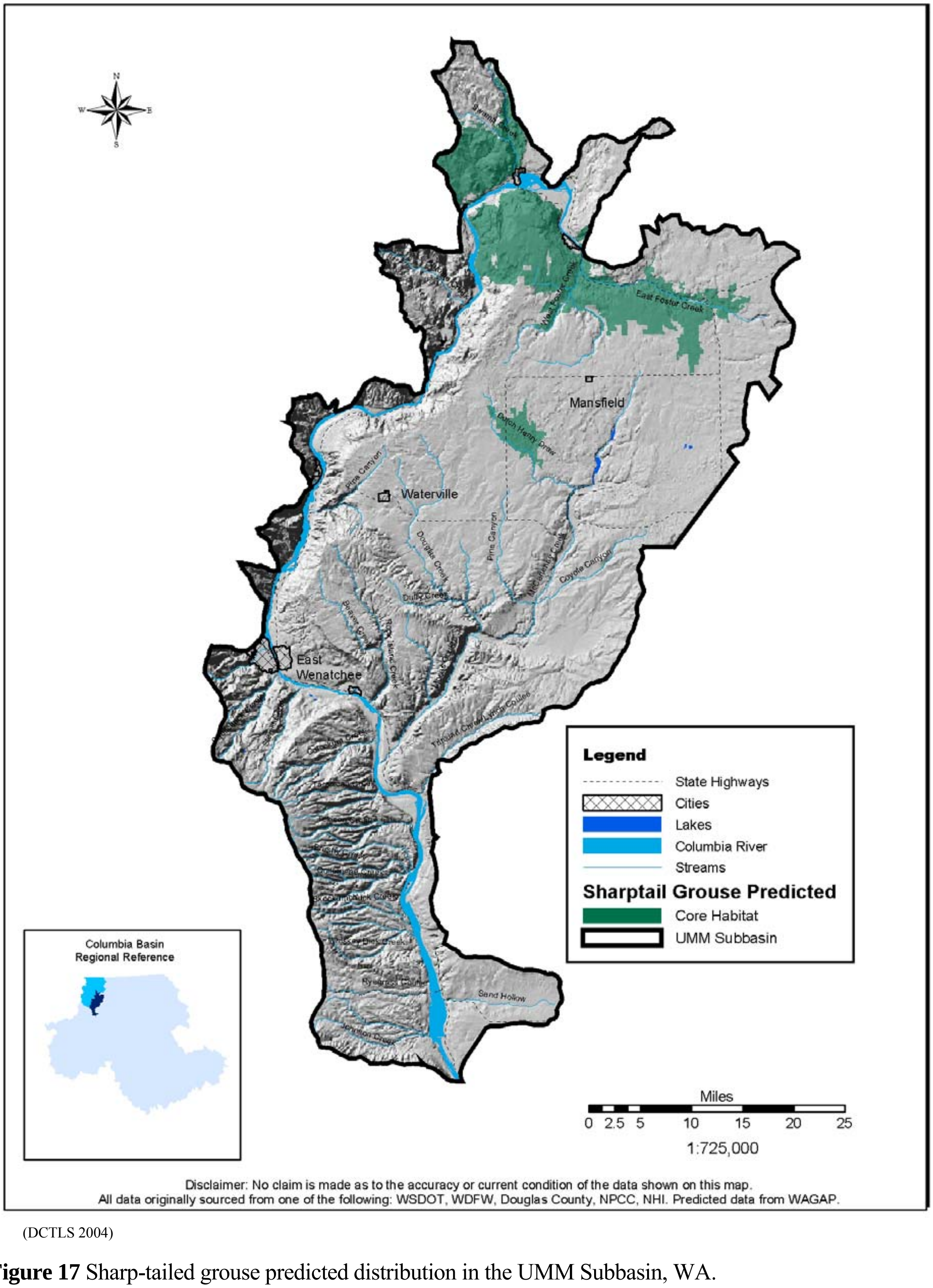
(DCTLS 2004)

Figure 15 Sage grouse predicted distribution in the UMM Subbasin, WA.



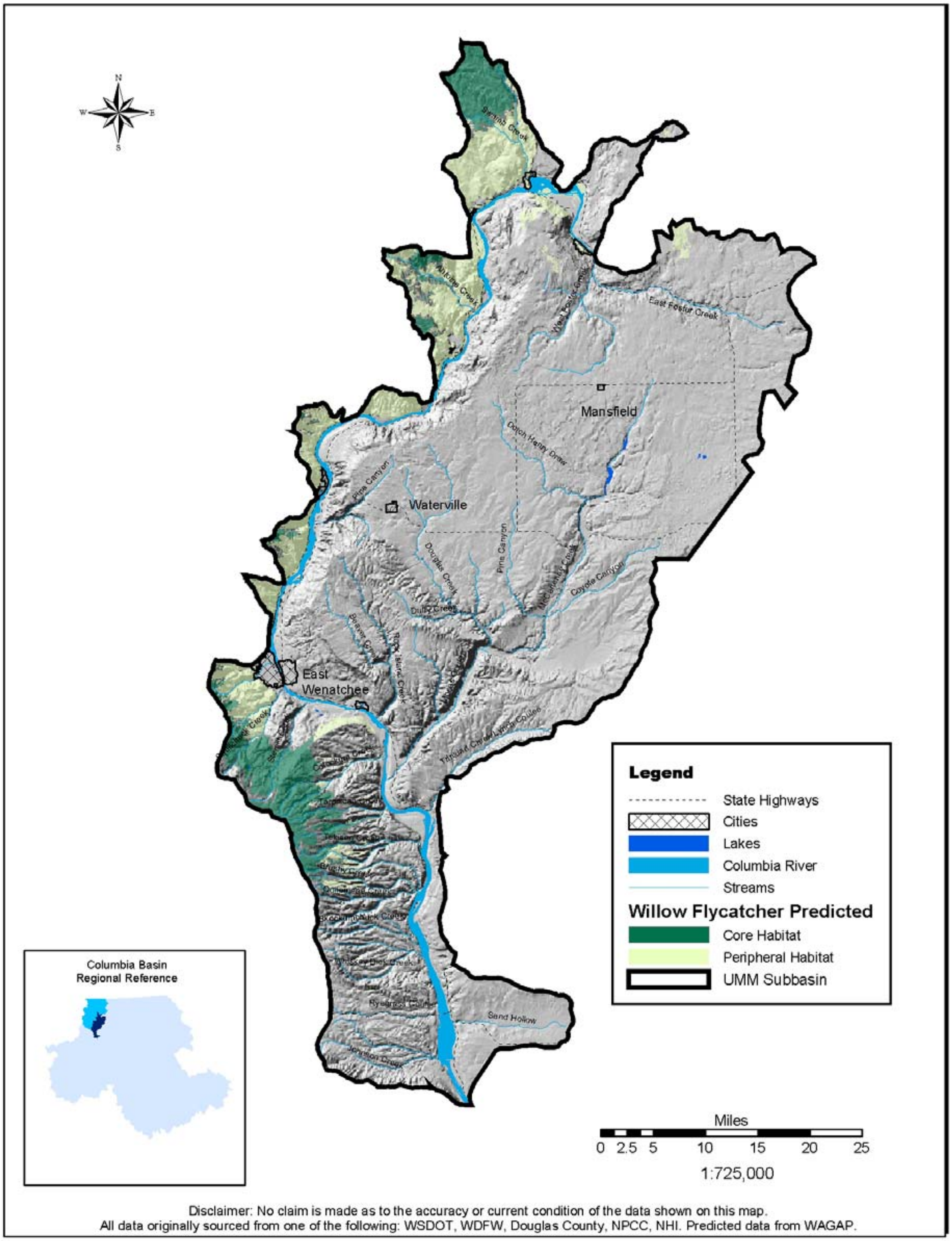
(DCTLS 2004)

Figure 16 Sharp-tailed grouse known distribution in the UMM Subbasin, WA.



(DCTLS 2004)

Figure 17 Sharp-tailed grouse predicted distribution in the UMM Subbasin, WA.



(DCTLS 2004)

Figure 18 Willow flycatcher predicted distribution in the UMM Subbasin, WA.

4.1.3 Aquatic/Fish

The UMM Subbasin supports at least 42 species of indigenous and introduced fish (Table 4, Appendix B). At least five anadromous fish species are found in the UMM Subbasin, including spring, summer/fall Chinook (*Oncorhynchus tshawytscha*), summer steelhead (*O. mykiss*), sockeye salmon *(O. nerka*), coho salmon (*O. kisutch),* and pacific lamprey (*Lampetra tridentata*). The Columbia River serves as a spawning, rearing and migration corridor to and from the Pacific Ocean each year for adult and juvenile salmon, steelhead, and pacific lamprey. Most fish species however, spawn and rear in tributary streams away from the Columbia River. Fall Chinook salmon spawning has been observed in limited areas in the Columbia River and in the mouth of the Chelan River. Fish distribution and production facilities in the UMM Subbasin are illustrated in Figure 19.

Whitefish, sturgeon, trout, and char were the dominant resident species in the reach before reservoir inundation. Bull trout, rainbow, white fish and white sturgeon are currently present in the reservoir along with numerous non-native species. Rainbow trout are present in the mid-Columbia reservoirs, however they are likely the result of hatchery steelhead and resident rainbow trout production programs in nearby tributaries. Resident rainbow trout do not appear to be self-sustaining in the reservoirs, though self-sustaining populations of rainbow, cutthroat, and brook trout are maintained in the tributaries (Chelan County PUD 1998; Zook 1983). It is believed that white sturgeon also spawn in the UMM Subbasin (Chelan PUD, unpublished data, 2001; Todd West, pers. comm., 2001 in Kaputa & Woodward 2002).

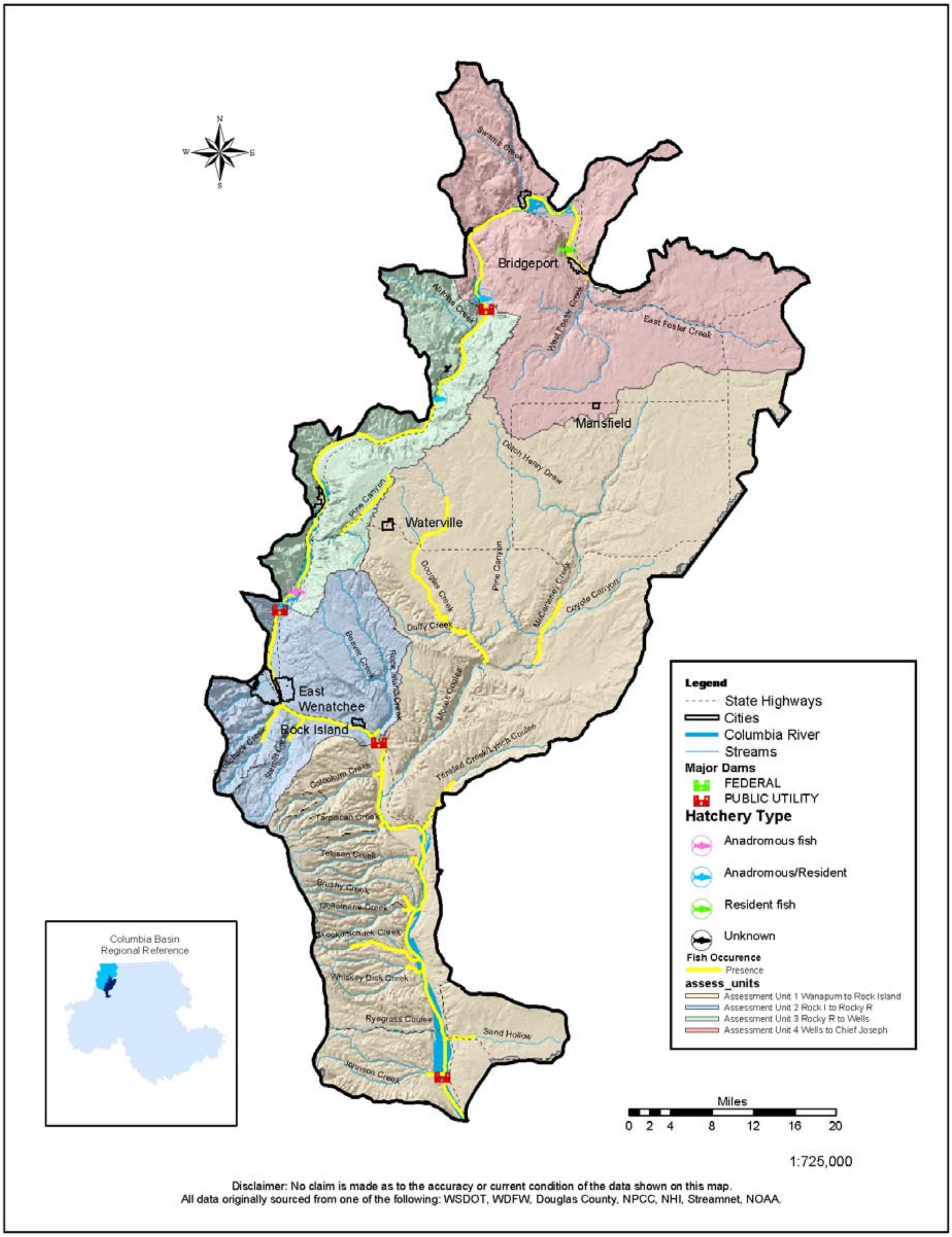
Hydropower development and production in the mid-Columbia created a subsequent shift in resident species composition toward dominance by cool water non-game species such as sucker, chub, northern pikeminnow, and shiners. Walleye peamouth, chiselmouth, carp, and perch are also found in the UMM Subbasin.

Focal Species Selection and Rationale

Of the 49 species of anadromous and resident fish found in the UMM Subbasin, two were chosen as aquatic focal species (Figure 19 Fish distribution and production facilities in the UMM Subbasin, WA.

Table 10): steelhead / rainbow trout (*O. mykiss*) and Chinook salmon (*Oncorhynchus tshawytscha*). These focal species were chosen because 1) they have one form or race that is on the Endangered Species List, 2) the small tributaries assessed have one or more of the life forms occurrence documented, and 3) their forms represent stream characteristics that historically occurred and are linked to wildlife species habitat requirements. All forms of *Oncorhynchus mykiss* and Chinook salmon, rather than one form, were used to model the streams as the occurrence and use within these tributaries is highly variable.

Species of interest include, sockeye salmon (*O. nerka)*, coho (*O. kisutch*), Pacific lamprey (*Lampetra tridentata*), sturgeon (*Acipenser transmontanus*), and bull trout (*Salvelinus confluentus*). These species were also considered for focal species status, but only occur in the Columbia River, which was not modeled as a part of this process. These species will be discussed, along with others, but only in the context of existing documents and in reference to the other five subbasins in the CCP where more life histories stages occur. Each of the focal species for the UMM Subbasin is described below.



(DCTLS 2004)

Figure 19 Fish distribution and production facilities in the UMM Subbasin, WA.

Table 10 Fish focal species and their distribution within the UMM Subbasin, WA.

Fish Focal Species	Habitat Attributes
Chinook Salmon	Columbia River and various $2^{nd}/3^{rd}$ order tributaries - Sensitive to water quality / temperatures.
Steelhead / Rainbow Trout	Columbia River and lakes - Found throughout the watershed, indicative of many habitat types.

4.1.4 Descriptions of Fish Focal Species and Species of Interest

(Information for this section taken from Peven 2003 except where noted)

Large runs of Chinook and sockeye, and lesser runs of coho, steelhead and chum historically returned to the Columbia River (Chapman 1986). By the 1880s, the expanding salmon canning industry and the rapid growth of the commercial fisheries in the lower Columbia River had heavily depleted the mid and upper Columbia River spring and summer/fall Chinook runs (McDonald 1895), and eventually steelhead, sockeye and coho (Mullan 1987, 1986, 1984; Mullan et al. 1992). The full extent of depletion in upper Columbia River salmonid runs is difficult to quantify because of limited historical records, but the runs had been decimated by the 1930s (Craig and Suomela 1941). Many factors including construction of impassable mill and power dams, un-screened irrigation intakes, poor logging and mining practices, overgrazing (Chapman et al. 1982; Bryant and Parkhurst 1950; Fish and Hanavan 1948), and private development of the subbasins, in combination with intensive fishing, all contributed to the decline in abundance of Upper Columbia basin salmonids.

Steelhead, Spring Chinook, Sockeye and Sturgeon Population Management

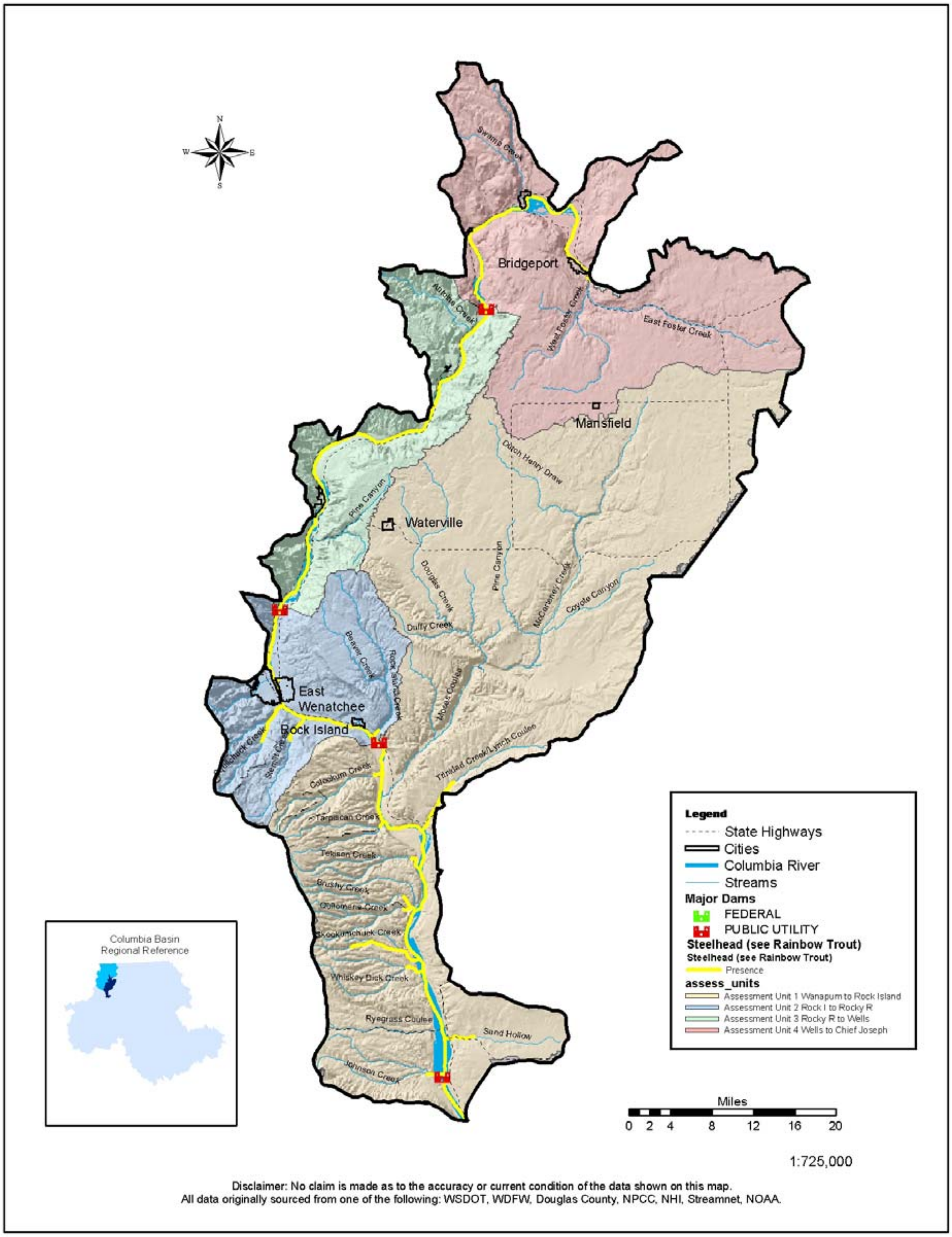
Steelhead, spring Chinook, sockeye and sturgeon populations in the UMM and its associated subbasins are managed by WDFW through: 1) the control of harvest with sport fishing regulations, 2) aquatic and riparian habitat protection and restoration and 3) the addition of hatchery-reared fish to naturally reproducing populations (supplementation). Hatchery steelhead and salmon rearing and release strategies have been developed to maintain as much genetic similarity as possible between supplemented and naturally produced fish and to minimize negative interactions among them. Funding for these efforts comes from WDFW and other agencies. WDFW receives funding for supplementation primarily from the Columbia River Hydroelectric projects. The USFWS also rears and releases steelhead and salmon into one of the UMM tributaries.

Fish Focal Species: Steelhead / Rainbow Trout

Steelhead is classified into two distinct races, or runs (Chilcote et al. 1980, Withler 1966, Smith 1960). Winter-run fish ascend streams between November and April, while summer-run fish enter rivers between May and October. In Washington state, winter-run fish are found primarily west of the Cascade Mountains, although both summer- and winter-run fish inhabit certain west side streams (Pauley et al. 1986, Kendra 1985). Winter-run steelhead is not found above of the Deschutes River in the Columbia River Basin (Pauley et al. 1986). In Washington, the Klickitat River is the uppermost tributary where winter-run fish are found (Kendra 1985). Steelhead runs on the Columbia River above the Deschutes River, and the entire Snake River are made up of exclusively summer-run fish. There are two groups of summer-run steelhead that ascend the

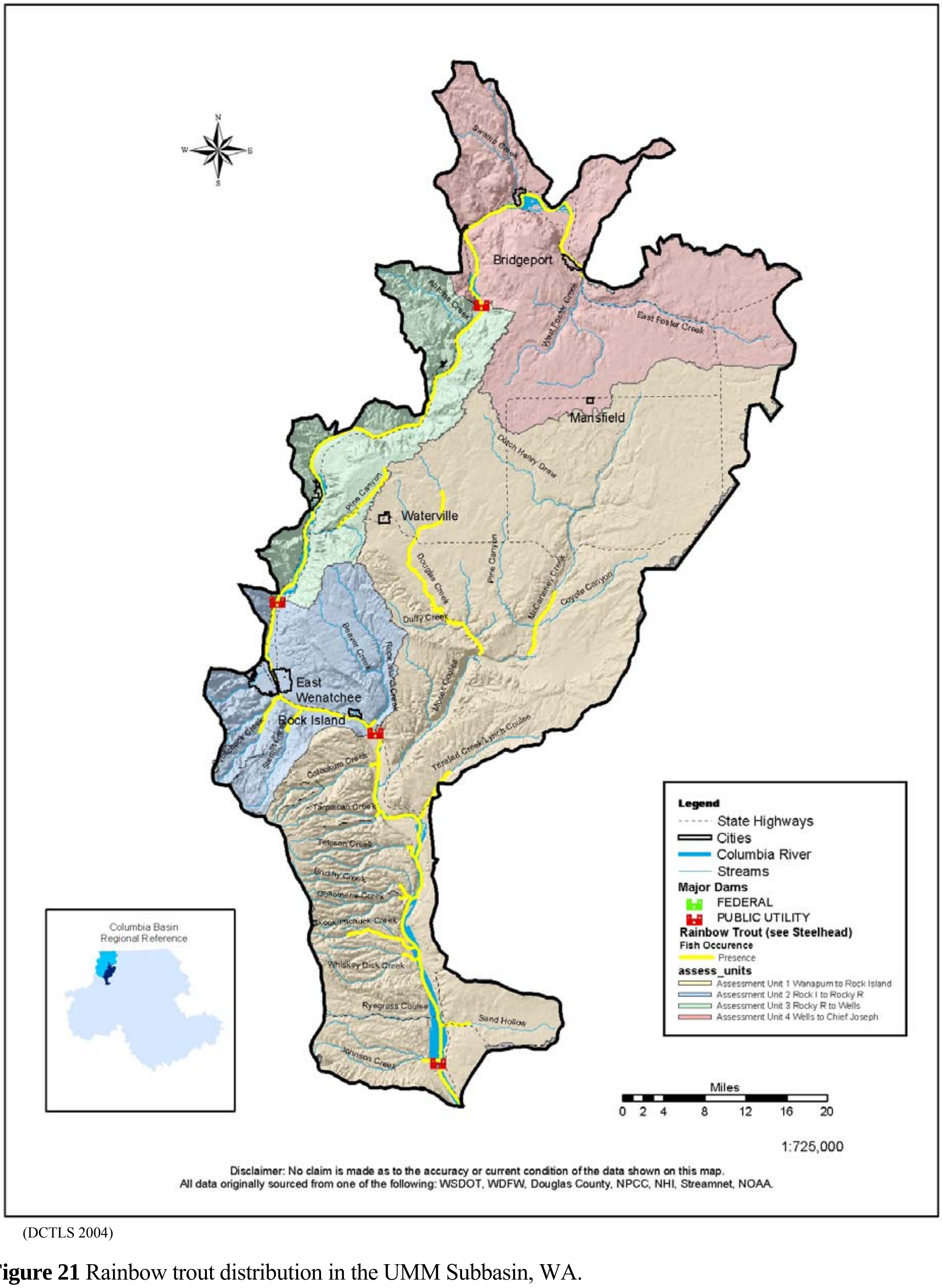
Columbia River. An early segment known as the “A” group, which enters the Columbia River in June and July, is the only native race of steelhead in the Upper Columbia. The “B” group enters the Columbia River during August and September and is made up of larger fish that are produced primarily in the Clearwater and Salmon rivers drainages (Chrisp and Bjornn 1978). Steelhead and rainbow trout distribution in the UMM subbasin are illustrated in Figure 20 and Figure 21.

Anadromy is not obligatory in steelhead/rainbow trout (*O. mykiss)* (Mullan et al. 1992a, Rounsefell 1958). Progeny of steelhead can spend their entire life in freshwater and progeny of rainbow trout can migrate seaward. It is difficult to summarize the life history strategy of anadromy without due recognition of the life history strategy of residency. The two strategies co-mingle on a continuum with certain residency at one end, and certain anadromy on the other. Anadromy, although genetically linked (Thorpe 1987), is influenced by environmental conditions (Mullan et al. 1992a, Thorpe 1987, Shapovalov and Taft 1954). The upstream distribution of steelhead/rainbow trout in headwater tributaries is limited by low heat budgets (about 1,600 temperature units) (Mullan et al. 1992b). The response of steelhead/rainbow trout in these cold temperatures is residency, presumably because growth is too slow within the time window for smoltification. However, these headwater steelhead/rainbow trout contribute to anadromy via emigration and displacement to lower reaches, where warmer water improves growth rate and subsequent opportunity for smoltification.



(DCTLS 2004)

Figure 20 Steelhead distribution in the UMM Subbasin, WA.



(DCTLS 2004)

Figure 21 Rainbow trout distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Steelhead in the Mid-Columbia Region are considered to be at high risk of extinction (Busby et al. 1996). Juvenile and adult summer steelhead use the Columbia River as a migration corridor and many tributary streams provide spawning and rearing habitat (Chapman et al. 1994b, Peven 1992b). Adult steelhead generally arrive in the UMM Subbasin from June through late September, though some adults arrive much later at the upstream dams. Steelhead generally spawn in the tributaries from March through July of the following year. No steelhead spawning has been observed in this reach of the Columbia River, but some could potentially occur, particularly in areas of substantial groundwater upwelling (CCPUD 1998). Wild steelhead juveniles emigrate during the spring, passing mid-Columbia dams from April through June. The outmigration generally peaks in late April and early May. No information is available about the feeding habitats of steelhead juveniles in the upper middle Columbia reach (CCPUD 1998).

Population Status

Adult steelhead returns declined substantially in the mid-1990s, remained low for several years, and then increased substantially in 2000 and 2001 (CCPUD, unpub. data, 2001; Mosey and Murphy 2000). Although 2001 adult steelhead counts were still in progress at Rock Island Dam at the time the Subbasin Summary was written, 18,012 steelhead had been counted as of September 17, 2001, the largest return since 1986 (Figure 22).

In a study of the resident fish community in 11 tributaries of the Priest Rapids Project Area (PRPA) during 1999, (Pfiefer et al. 2001) juvenile rainbow trout were the most abundantly sampled species. The highest abundance of juvenile rainbow trout was found in Whiskey Dick Creek, followed by Colockum, Johnson, and Tarpiscan creeks. The study also included a genetic analysis for steelhead, rainbow, and redband trout. Objectives of the research were: to provide baseline information concerning the genetic diversity, variation, and genetic population structure of redband/rainbow trout and to determine whether genetic structuring observed in rainbow trout populations in the PRPA is indicative of pure, native trout populations or indicative of populations that have undergone introgression with hatchery rainbow trout or steelhead.

Genetic analysis was performed on tissue from a sub-sample of trout collected during the 1999 surveys (Dresser, pers. comm., 2003). Genetic analysis was also performed on fifty hatchery rainbow trout, fifty hatchery steelhead and twenty-three wild steelhead tissue samples (Wells Hatchery) for comparison purposes. Results of the analysis indicate four genetic "categories": 1) resident redband/rainbow trout (this includes all stream sample locations except Johnson Creek), 2) a unique stream population in Johnson Creek, 3) a hatchery rainbow trout component, and 4) steelhead populations.

Grant PUD also assessed the upstream and downstream migration of adult steelhead through the mid-Columbia River using radio-telemetry techniques during October 1999 and June 2000 (English et al. 2001). During aerial tracking efforts, no adult steelhead was found in the tributaries of the PRPA. Further details on adult steelhead movements/migration in the mid-Columbia River can be reviewed in English et al. (2001).

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Figure 22 Adult Steelhead Counts at Rock Island Dam 1980- September 17, 2001

Population Management

Hatchery

The Federal Energy Regulatory Commission (FERC) requires that each hydroelectric project located on the Columbia River between Wanapum and the Chief Joseph dams mitigate for steelhead killed while migrating through project dams. To comply with this requirement the hydroelectric projects have funded the construction of hatcheries at four hydroelectric projects. The projects also fund WDFW to run the hatcheries and rear and release steelhead into Columbia River tributaries. Four of the six hydroelectric dams between Wanapum and Chief Joseph Dam include hatcheries these are: Wells, Eastbank, Chelan and Ringold hatcheries. The Winthrop National Fish Hatcheries also rears steelhead and releases them into a tributary to the UMM Subbasin.

Current WDFW management for steelhead emphasizes separation of above Wells Dam and below Wells Dam populations. Two separate hatchery broodstocks have been created. Adult steelhead is trapped in the Wenatchee River and in the Columbia River at Wells Dam. Only the progeny from fish trapped in the Wenatchee River are stocked in waters below Wells Dam. Only the progeny from fish trapped at Wells Dam are stocked in waters above Wells Dam.

Below Wells Dam

About 360,000 juvenile steelhead from the Eastbank and Chelan Hatchery Complex are released into the Wenatchee River. About 175,000 juvenile steelhead are released directly into the mainstem Columbia River from Ringold Springs Hatchery.

Steelhead supplementation was ceased in the Entiat River in 2001. Changes in steelhead population abundance in the Entiat River will be compared to other supplemented rivers to learn how effective supplementation is at increasing numbers of naturally produced steelhead.

Above Wells Dam

About 400,000 juvenile steelhead from the Wells Hatchery Complex are distributed among the Chewuch, Twisp, Methow, Okanogan and Similkameen rivers; the Winthrop National Fish Hatchery stocks 100,000 juvenile steelhead into the Methow River. A more detailed description of hatchery operations and supplementation efforts can be found in the WDFW Steelhead Management and Conservation Plan 2001.

Fish Focal Species: Chinook Salmon

Adult Chinook that spawn in the upper reaches of the ESU watersheds, generally return past Columbia River dams in the spring and are known as spring Chinook. Natural spring Chinook production is not known to occur in the UMM Subbasin, although migration and rearing in the mainstem and some of the small tributaries does.

Brannon et al. (2002) identified two populations of summer/fall Chinook salmon in the mid- and upper- Columbia region. Mainstem spawners downstream of Rock Island Dam (which includes the Hanford Reach) were designated as part of a metapopulation belonging to the mid-Columbia and Snake River populations, which includes the Klickitat, Deschutes, John Day, lower portions of the Grande Ronde, and Clearwater rivers. Upstream of Rock Island Dam (the lower Wenatchee, Okanogan, Similkameen, and mainstem Columbia River), spawners are characterized as one metapopulation. Spring Chinook and summer/fall/Chinook distribution in the UMM are illustrated in Figure 23 and Figure 24.

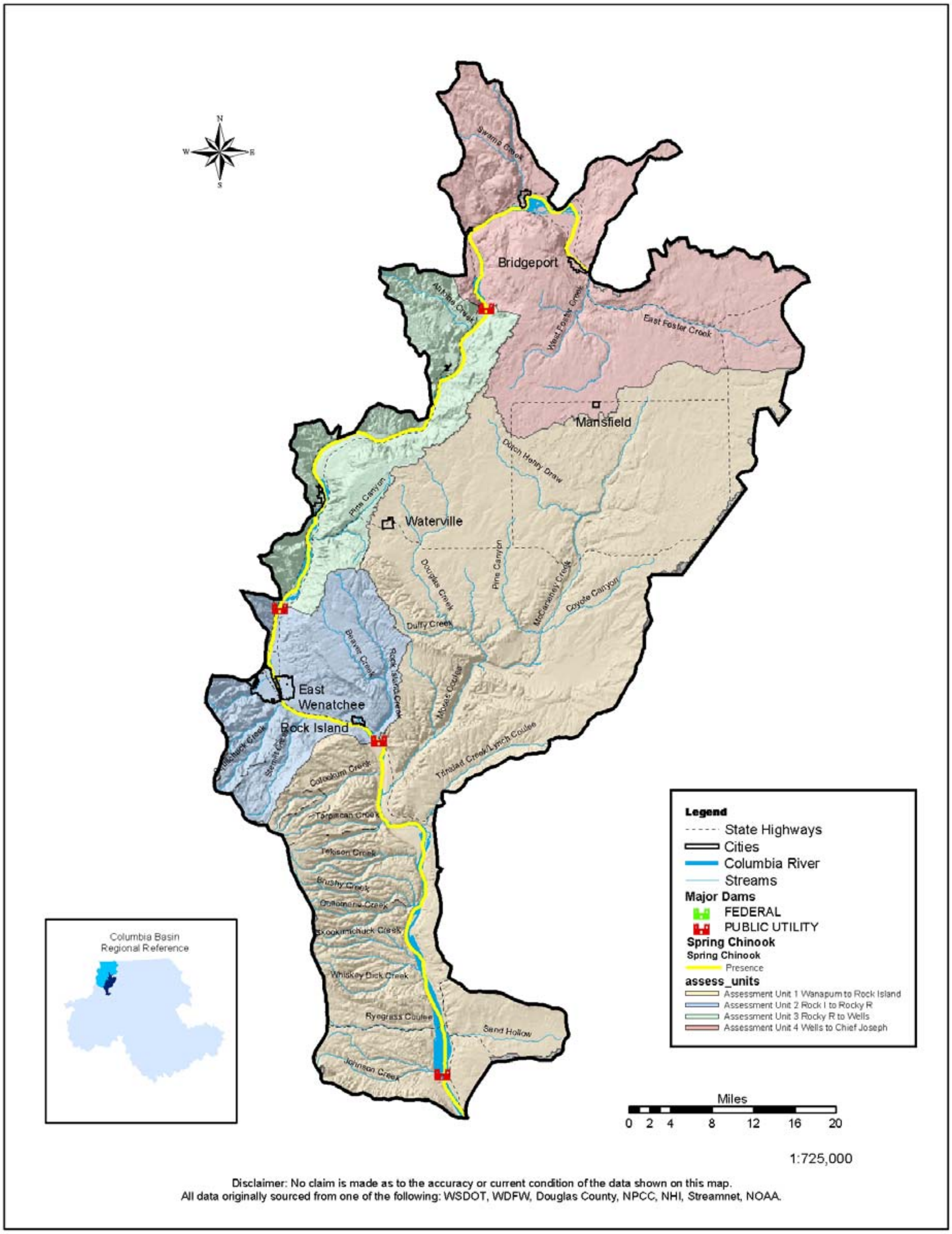

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Figure 23 Spring Chinook distribution in the UMM Subbasin

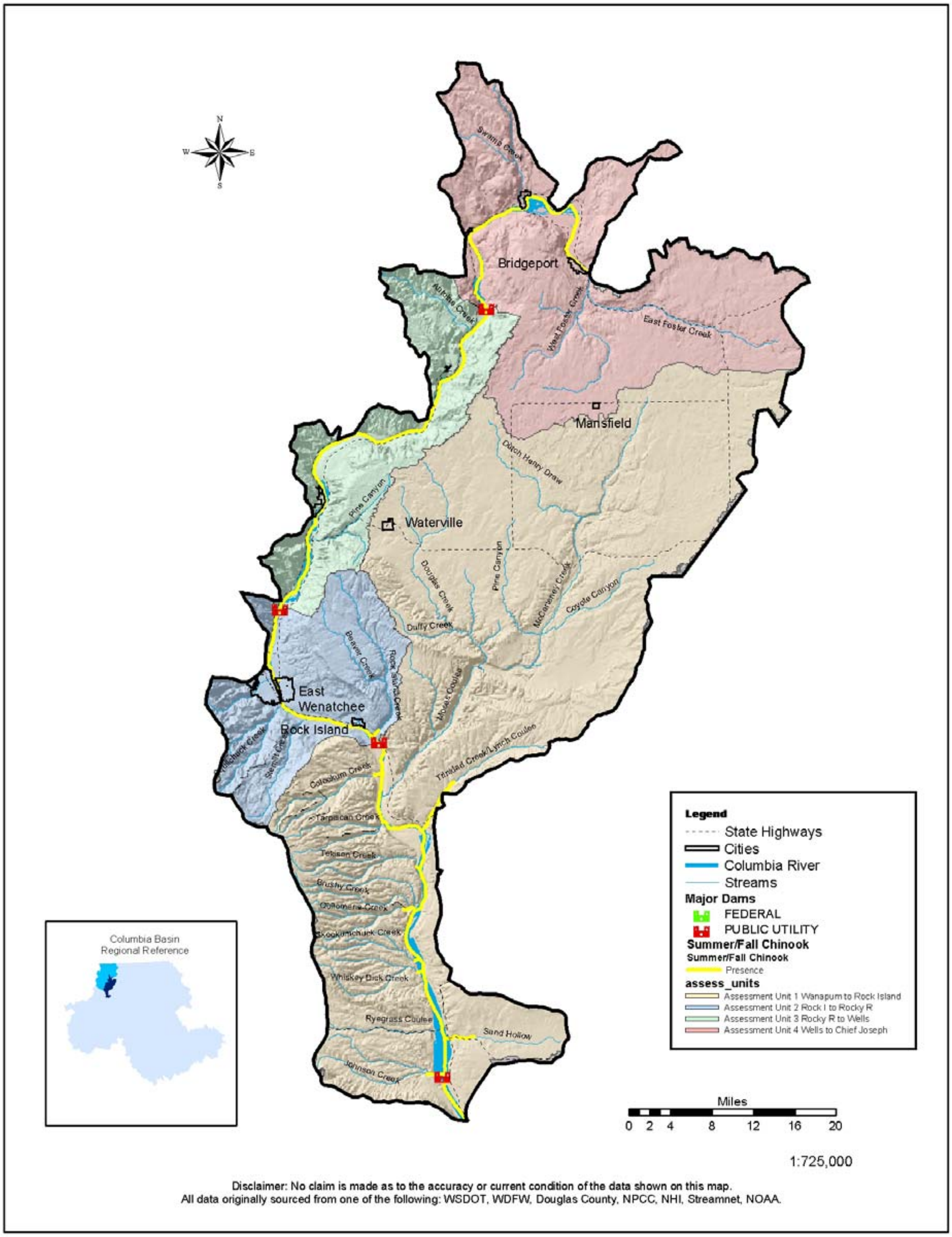

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Figure 24 Summer/Fall Chinook distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Spring Chinook

Upriver migrations of adult spring Chinook salmon through Rock Island Dam are generally observed in early April through the third week of June (Mosey and Murphy 2000). Spawning occurs in the upper reaches of tributary streams, including the Wenatchee, Entiat, and Methow river systems, from early August through most of September, though the timing of spawning varies among tributaries. After spawning, adult spring Chinook remain near their redds until death.

Eggs hatch in late winter and early spring and the fry emerge from the gravel in April and May (Peven 1992a). Shortly after emergence, juveniles may migrate to rearing areas farther upstream or downstream. Most juvenile spring Chinook salmon rear in tributary streams to the Columbia River for approximately one year and then migrate downstream to the ocean (age 1+) when smoltification occurs. Smolts pass through the mid-Columbia dams from mid-April through mid-June. A small percentage migrate as sub-yearlings (age 0+) into lower reaches of their watersheds for overwintering before migrating to the ocean (Chapman et al. 1995a).

In 1993, the average length of yearling Chinook collected at Rock Island Dam (mixture of naturally and hatchery produced individuals) was 138 mm (Chapman et al. 1995a). In general, hatchery smolts are larger than wild smolts at the time of migration. Juvenile spring Chinook in the mid-Columbia migrate actively (averaging about 21.5 km/day from Rock Island to McNary Dam), thus the reservoir residence time is relatively short (Giorgi et al. 1997).

Summer/Fall Chinook

Summer/fall Chinook salmon have similar life history strategies and are combined in much of the discussion in this Plan. Summer/fall Chinook spawn in the mid-Columbia River and its tributaries, where suitable habitat prevails. Juveniles spend several weeks to months in Columbia River reservoirs before outmigrating through the UMM, between June and August (Chapman et al. 1994a, Peven 1992a), to the ocean where they spend 2-4 years (Peven 1992a). Apparently, some juveniles use the mainstem Columbia River to overwinter before entering the ocean in their second year of life. Adults usually spend two years in the ocean, but in some years a significant proportion of the run is composed of fish that spend 1 or 3 years in the ocean. Summer/fall Chinook show similar life histories and cannot be distinguished on the spawning grounds. Summer/fall Chinook return to the Columbia River between late May and early July and begin entering the UMM in mid- to late June through mid November. Some migrate up tributaries and spawn in late September through November, while others spawn in the mainstem between October and November. After spawning is complete, the adults die near their redds.

Summer/fall Chinook are known to spawn in the Wells and Chief Joseph dam tailraces as well as the confluence of the Chelan River (Chapman et al. 1994a). Spawning in the Chelan River is limited to the short segment below the Chelan powerhouse. In 1990 and 1991, Giorgi (1992) found Chinook redds in the Chelan River between the boat ramp and about 150 feet downstream from the railroad bridge.

Chapman et al. (1994a) suggested Columbia River spawning was continuing in the Brewster Bar area following inundation by the Wells reservoir. Other surveyors have indicated potential deep water spawning near Bridgeport Bar, Washburn Island, and downstream of Wanapum Dam

(Bickford 1994, Chapman et al. 1994a, Hillman and Miller 1994, Swan et al. 1994, GCPUD 2003a). They probably also spawn below other mid-Columbia River dams (Dauble et al. 1994), and perhaps in other Columbia River reservoir segments where suitable water velocities and substrate conditions exist.

Population Status

Spring Chinook

Spring Chinook were relatively abundant in upper Columbia River tributary streams prior to the 1860s. Based on the peak commercial catch of fish in the lower Columbia River and other factors, such as habitat capacity, Chapman (1986) estimated that approximately 588,000-spring Chinook was the best estimate of pre-development run sizes. Spring Chinook counting at Rock Island Dam began in 1935. Numbers (adults and jacks) in the period 1935-39 averaged just over 2,000 fish. Average counts fluctuated on a decadal average from the 1940s to 1990s from just over 3,200 (1940s) to over 14,400 (1980s). Within the past 10 years, counts of spring Chinook declined to near record lows and remained low for four consecutive years from 1995-1999 (Mosey and Murphy 2000). In 2000 and 2001, adult returns increased dramatically, with 41,262 adult spring Chinook counted at Rock Island Dam in 2001, marking the highest recorded return. Ten-year average counts (1991-2000) for anadromous adult salmonids migrating through Rock Island Dam, Rocky Reach and Wells Dams are presented in **Table 11**. The long-term average of spring Chinook passing Rock Island Dam is just over 8,900.

Table 11 Ten year average (1991-2000) counts of adult salmon and steelhead migrating upstream through UMM hydroelectric projects (Mosey and Murphy 2000)

Location	Chinook (jacks included)	Steelhead	Sockeye	Coho
Rock Island Dam	25,597	7,129	36,080	42
Rocky Reach Dam	11,241	4,934	18,714	24
Wells Dam	5,814	3,894	17,095	32

Since 1970, hatchery production of spring Chinook juveniles has increased, and the run is now comprised of at least 60 to 70 percent hatchery adults (CCPUD 1998, BPA et al. 1994, Palmisano et al. 1993). In 1993, stream-type Chinook salmon hatchery juvenile releases to the mid-Columbia reach totaled 4,171,000 (CCPUD 1998, BPA et al. 1994). Hatchery produced stream-type Chinook smolts migrating through the mid-Columbia originate from Winthrop, Methow, Entiat, Eastbank, Leavenworth and WDFW operated hatcheries (CCPUD 1998).

Summer/Fall Chinook

At Rock Island Dam, counts of adult summer/fall Chinook ranged from 6,874 to 48,844 between 1980 and 2001 and fall Chinook ranged from 1,706 to 6,846 fish between 1980 and 2000. The estimated number of adult fall Chinook salmon in the Priest Rapids Project (downstream of Wanapum Dam) was 10,971, 8,336, and 9,202 for 2000, 2001, and 2002, respectively (GCPUD 2003). Summer/fall Chinook populations in the UMM exhibited large increases in 2000 and 2001, similar to the increases observed for most other anadromous species (CCPUD unpublished data 2001, Mosey and Murphy 2000).

Population Management

Hatchery

Spring Chinook

To comply with FERC mitigation requirements, the Columbia River Hydroelectric projects fund Wells, Eastbank, and Methow hatcheries to rear and release juvenile spring Chinook into the tributaries of the UMM Subbasin. In addition, the Entiat and Winthrop National Fish Hatcheries rear and release juvenile spring Chinook. Table 12 provides an example of annual spring Chinook stocking into the UMM Subbasin and its tributaries.

Table 12 Annual Spring Chinook Stocking in the UMM Subbasin and its tributaries

Hatchery	Release Site	Approximate Number Released	Stock
Entiat NFH	Entiat River	375,000	Carson River
East Bank Hatchery	Wenatchee	400,000	Upper Columbia
Leavenworth NFH	Icicle Creek	1,289,000	Carson River
Methow Hatchery	Methow River	450,000	Methow River
Wells Hatchery	Main Stem Col. River	313,000	Upper Columbia
Winthrop NFH	Methow River	500,000	Methow River

Summer/Fall Chinook

Hatchery production of summer/fall Chinook in the region has been continuous since implementation of the Grand Coulee Fish Maintenance Project (GCFMP). Management practices have not changed since the implementation of the GCFMP.

Summer Chinook broodstock are collected randomly throughout the July-August migration to ensure proportional representation of age and size. Trap sites include Dryden and Tumwater dams on the WenatcheeRiver, the Wells Dam east ladder, and the Wells Hatchery outfall on the Columbia River.

The fish collected from Wenatchee River and Okanogan/Methow summer Chinook populations are natural or hatchery origin and are indigenous to those systems. Summer Chinook program protocols allow for annual collection of 492 adults for the Wenatchee, 556 for the Wells east ladder, and 1,210 for the Methow/Okanogan programs. The only broodstock program that uses selection criteria for a particular trait or parental origin is the Wells and Rocky Reach/Turtle Rock mitigation programs. These programs use fish collected at Wells Dam east ladder that are a mix of hatchery and natural fish.

Summer Chinook collected from the Wenatchee River and at Wells Dam are maintained separately at Eastbank Hatchery and spawned at a 1 male to 1 female ratio to help maintain genetic diversity. The program survival standard from fertilization to ponding is 90.0 %. The survival objective from fertilization to release is 65.0 %.

The rearing conditions at Wells and Eastbank hatcheries, including acclimation ponds, are based on loading densities recommended by Piper et al. (1982; 6 lb/gpm and 0.75 lb/ft^3) and Banks

(1994; 0.125 lb/ft^3/in) (BAMP 1998). Fry are transferred from Heath incubation trays to fiberglass rearing tanks (flow through water circulation), and then to raceways for continued rearing. Summer Chinook are transferred as fingerlings or sub-yearlings to acclimation ponds in the Wenatchee, Methow, and Similkameen drainages in the fall (September or October) or late winter (February or March) to acclimate and imprint the fish to the desired up-river return locations. Summer Chinook yearlings and sub-yearlings produced at Wells Hatchery are reared entirely at the hatchery and fully acclimated to the release site, while those released from Turtle Rock Hatchery are transferred from Rocky Reach Hatchery in November (yearlings) for six months of acclimation (April release), and in April-May (sub-yearlings) for three months of acclimation (June-July release).

Ocean-type Chinook salmon are released from hatcheries at both the yearling and sub-yearling stages. The current annual production goal for the combined programs is 2.36 million yearling smolts and 2.104 million sub-yearling smolts. Assuming a fertilization to release percent survival standard of 65.0 %, 6.87 million summer Chinook eggs are needed each year for the program. All summer Chinook smolts, except the Rocky Reach/Turtle Rock sub-yearlings (200K index group), produced through the programs are marked with an adipose clip/coded wire tag combination.

Chapman et al. (1994b) proposed an escapement objective to basin tributaries above Wells Dam of 3,500; a level carried forth in the "Mid-Columbia Hatchery Plan" as a natural escapement goal (BAMP 1998). A baseline adult production objective for the summer Chinook salmon population reaching Rocky Reach Dam is 30,293 (BAMP 1998).

Currently, summer/fall Chinook salmon have a low risk of extinction in the UMM; more are artificially propagated in the region than any other species. Most hatcheries rear them to a yearling stage because survival is up to 15 times higher than subyearlings. In addition, fewer yearlings need to be propagated to meet required compensation levels. In the short-term, this strategy appears to have few ecological impacts on natural fish; however, some indicators are inconclusive. This strategy, in combination with relatively high numbers of naturally spawning hatchery fish, may have deleterious long-term genetic effects to natural fish and may be impossible to detect in a timely manner. Given these constraints, the chosen strategy is to continue to propagate yearlings to compensate for dam mortalities; evaluate the genetic, ecologic, and demographic characteristics of the natural populations throughout the hatchery program; and recognize the risk that potential impacts may not be detected in sufficient time to correct them (DCPUD 2002).

Hatchery production of summer Chinook occurs at the Wells, Eastbank and Rocky Reach/Turtle Rock hatcheries in the mid-Columbia. Fall Chinook above McNary Dam are reared at Priest Rapids and Rocky Reach hatcheries (BPA et al. 1994).

WDFW operates and manages the Upper Columbia Summer Chinook Salmon Mitigation and Supplementation Program at the Eastbank (Rocky Reach and Rock Island Settlement Agreements) and Wells (Wells Settlement Agreement) Fish Hatchery Complexes. These "integrated harvest" programs pertain to Upper Columbia River Summer and Fall run ESU Chinook salmon (i.e., summer run component upstream of Priest Rapids Dam). Hatchery operations include broodstock capture and holding, fish spawning, incubation, rearing, and rearing to release (DCPUD 2002).

Current Hatchery Production and additional production to compensate for hydropower losses are detailed in Table 13. Current hatchery production totals 2,360,000 yearlings and 7,104,000 subyearlings, while additional production totals 1,470,000 yearlings and 1,000,000 subyearlings.

Table 13 Current and additional summer/fall Chinook hatchery production to compensate for hydropower losses in UMM Subbasin, WA.

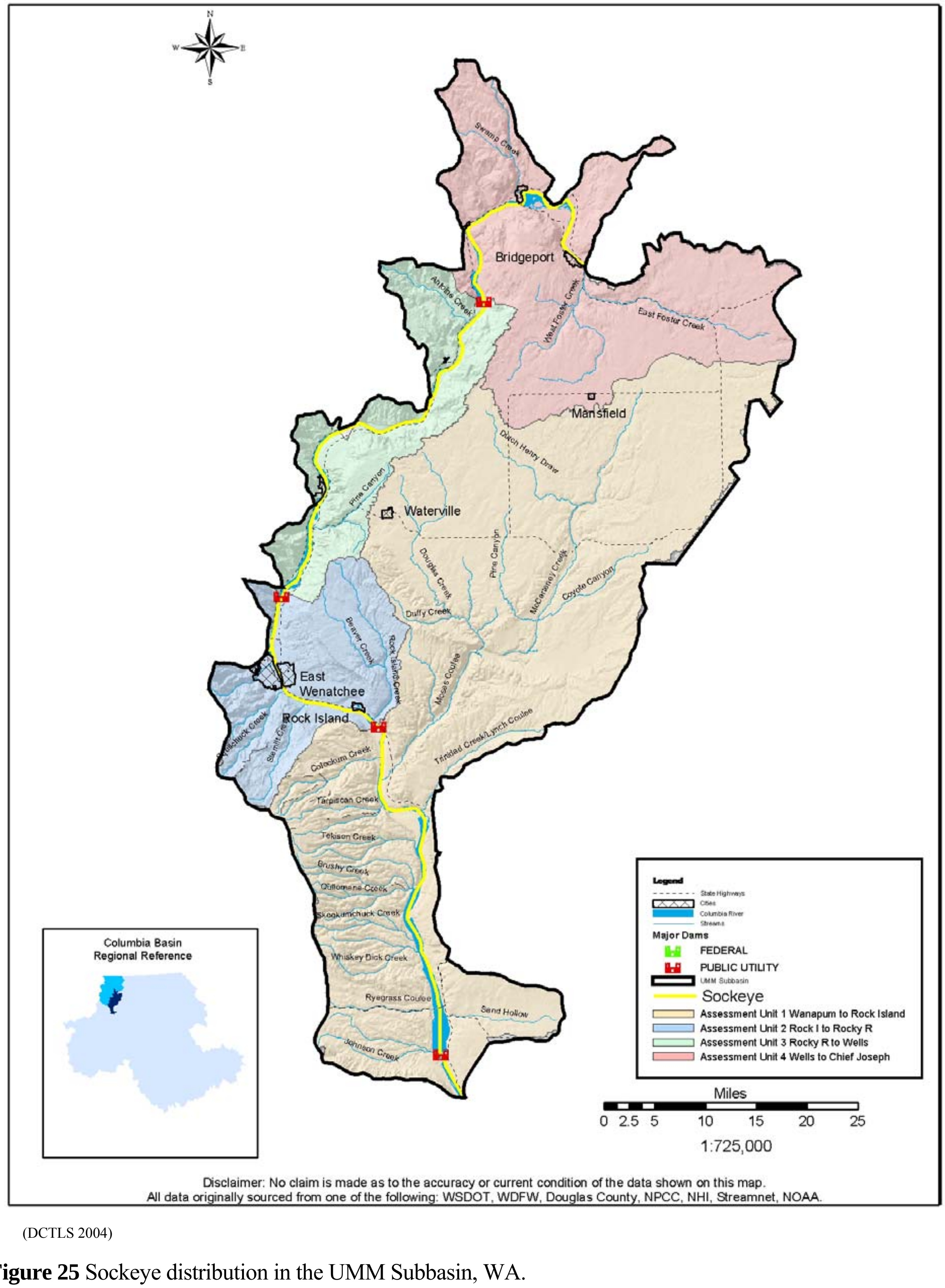
Hatchery	Size	Number
Wenatchee	Yearlings	864,000 plus 750,000 HP*
Methow	Yearlings	400,000 plus 120,000 HP*
Okanogan	Yearlings	576,000
Columbia River at Wells Fish Hatchery	Yearlings	320,000
Columbia River at Wells Fish Hatchery	Subyearlings	484,000
Rocky Reach Fish Hatchery	Yearlings	200,000
Rocky Reach Fish Hatchery	Subyearlings	1,620,000
Priest Rapids Fish Hatchery	Subyearlings	5,000,000 plus 1,000,000 HP
Entiat	Yearlings	150,000 HP*
Chelan River	Yearlings	150,000 HP*
Chief Joseph Dam area	Yearlings	300,000*

*HP- additional mitigation for losses at hydropower projects.

(Chuck Peven, pers. comm., 2004)

Fish Species of Interest: Sockeye

Sockeye salmon populations spawn and rear in the Wenatchee and Okanogan Rivers and use the Columbia River within the UMM Subbasin as a migration corridor (Figure 25). Sockeye are not listed under the ESA.



(DCTLS 2004)

Figure 25 Sockeye distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Sockeye salmon populations from the Wenatchee and Okanogan Rivers use the Columbia River within the UMM for migrations as adults and juveniles (Peven 1987). Adult sockeye migrate up the Columbia River between June and August with the peak generally occurring at Rock Island Dam in mid-July. Juvenile sockeye migrate downstream in April and May with Lake Wenatchee fish arriving at Rock Island Dam before Osoyoos Lake fish (Peven 1987).

Sockeye spawn and rear in the upper Wenatchee basin and Okanogan River / Osoyoos Lake area at the US / Canadian border. The two stocks are separable by caudal fork length frequency distributions. The tail fork length of Osoyoos Lake stock is generally larger than 100 mm and the Wenatchee stock is less than 100 mm (Peven 1987b).

Population Status

Since 1980, adult counts at Rock Island Dam have ranged from 9,334 to 109,074 (Mosey and Murphy 2000). In 2001, 104,842 adult sockeye passed Rock Island Dam making it the largest return since 1984.

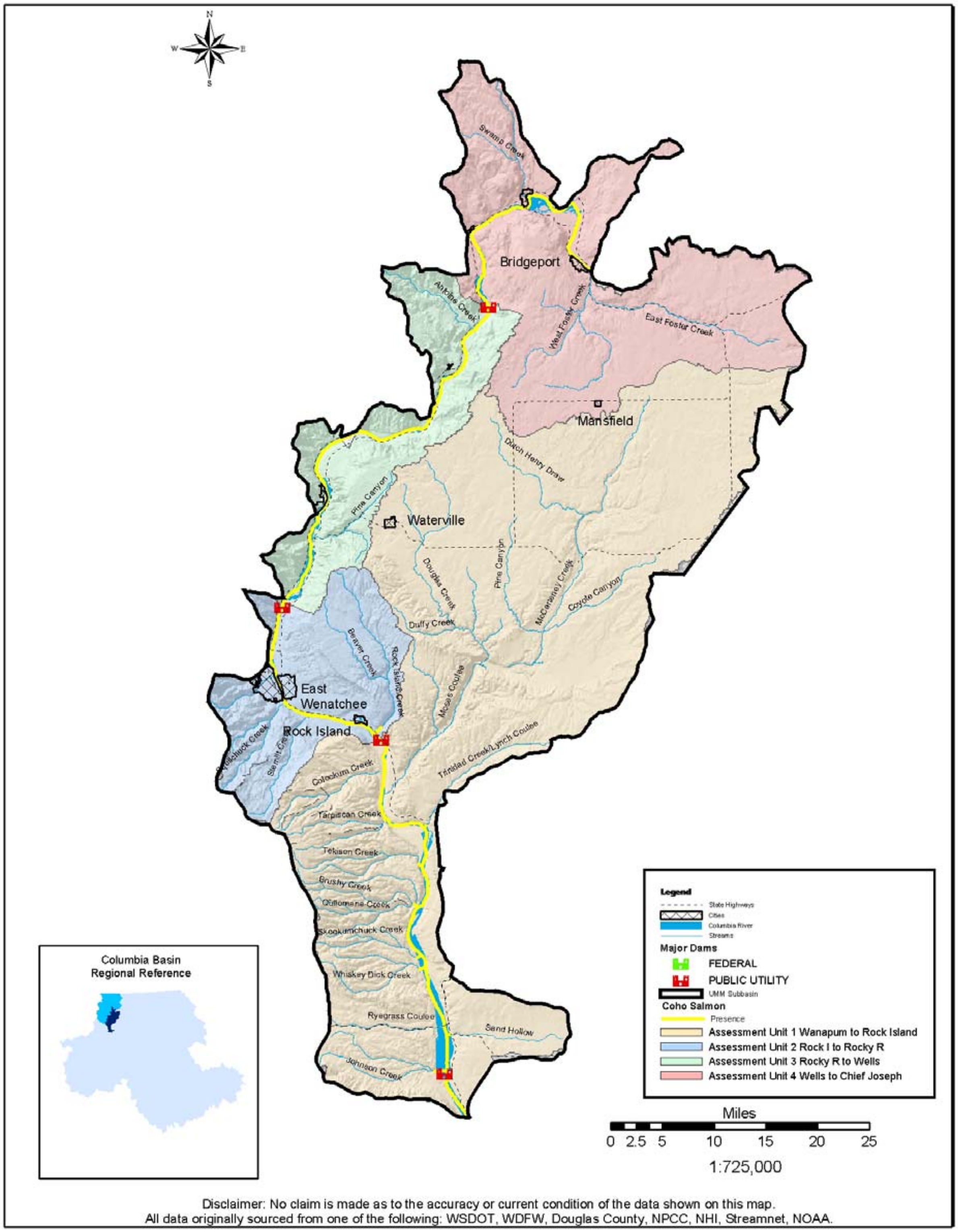
Population Management

Hatchery

Currently the only sockeye supplementation program conducted in the UMM occurs in Lake Wenatchee in the Wenatchee River drainage. Eggs are taken from naturally reproducing fish in the White River, a tributary to the Lake Wenatchee. The eggs are reared at Eastbank Hatchery to fingerling size and then transferred to net pens in Lake Wenatchee and released in the early summer or fall. Approximately, 209,000 juvenile sockeye have been stocked annually.

Fish Species of Interest: Coho

An endemic stock of coho salmon once spawned in several tributaries to the UMM Subbasin, but has been extirpated from this region since the 1930s. Current distribution of hatchery coho in the UMM Subbasin, released as part of the Yakama Nation/WDFW Reintroduction Feasibility Study (BPA et al. 2002), is illustrated in Figure 26.



(DCTLS 2004)

Figure 26 Coho distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Historically, coho salmon migrated through Wells reservoir to spawning areas in several tributaries to the UMM Subbasin (DCPUD 2002). The endemic stock has been considered extinct in the mid- and upper-Columbia River regions, including upstream of the Wells Project, since the 1930s (CBFWA 1990, Mullan 1984), despite plantings of 46 million fry, fingerlings, and smolts from fish hatcheries between 1943 and 1975 (Andonaegui 1999). The State of Washington does not currently recognize any natural coho stock in the UMM Subbasin (WDF/ WDW 1993). The Wells HCP includes mitigation and off site compensatory measures for coho salmon (DCPUD 2002).

Population Management

In the early 1900s, a fish hatchery in the Methow Basin raised primarily coho salmon. Between 1904 and 1914, an average of 360 females were used for broodstock from this hatchery annually. Between 1915 and 1920, an average of only 194 females were taken, suggesting a 50% decline in the run between this and the previous period. After 1920, no coho were taken from this hatchery and it was closed in 1931 (Mullan 1984).

No further releases of coho into the Methow River occurred until the GCFMP in 1945. The Winthrop National Fish Hatchery released coho in 17 of the 24 years between 1945 and 1969. In only four of those years did the broodstock originate from the Methow River, which were admixtures of various stocks originally captured at Rock Island Dam. Most of the coho released at Winthrop originated from Lower Columbia River stocks from the Eagle, Lewis, and Little White Salmon hatcheries (Mullan 1984). No further releases of coho occurred into the Methow River until the late 1990s.

The first hatchery opened in the Wenatchee Basin in 1899 near Chiwaukum Creek. It closed 5 years later (Craig and Suomela 1941). Besides logistical problems (e.g., heavy snow, extreme cold, etc.), the hatchery was unable to obtain eggs of Chinook, which were evidently its prime target. Mullan (1984) quotes from the 14th and 15th annual report of the State Fish Commissioners of Washington: "… if it [the hatchery] had been below the Tumwater Canyon, the early Chinook could have been secured; as it is, it takes only an inferior run of coho."

In 1913, a new hatchery was built, below Tumwater Canyon, near the town of Leavenworth. Very few spring Chinook, the target species, were collected there. Subsequently, the hatchery closed in 1931. Mullan (1984) reports that there were, at most, two plants of coho from this hatchery, utilizing lower Columbia River source fish.

No further releases of coho occurred in the Wenatchee River until the GCFMP, with the first release in 1942. Between 1942 and 1975, most of the coho released at Leavenworth originated from Lower Columbia River stocks from the Cascade, Quilcene, Eagle, Lewis, and Little White Salmon hatcheries (Mullan 1984).

Hatchery

The Yakama Nation and WDFW are currently implementing a Reintroduction Feasibility Study funded by the BPA (BPA et al. 2002). The project is designed to gather data and develop and implement plans for coho restoration in the Wenatchee, Entiat, and Methow river sub-basins. The Yakima Subbasin has sufficient productivity to sustain a meaningful in-basin fishery in most years. The study focuses on the development of a localized broodstock while minimizing potential negative interaction among coho and listed and sensitive species. As the study transitions from the exclusive use of lower Columbia River hatchery coho to the exclusive use of in-basin returning broodstock, a locally adapted broodstock will develop and it is expected that positive trends in smolt-to-adult survival will be observed. The first phase evaluates the initial feasibility and risks associated with coho restoration through intensive experimental monitoring and evaluation.

Monitoring and evaluation activities in the Wenatchee subbasin have focused on evaluating the success of broodstock development, associated survival rates, and examining interactions between coho and listed species, particularly spring Chinooksalmon, steelhead, sockeye salmon, and bull trout. The program relies on the transfer of non-basin specific information from the Methow and Yakima river basins where concurrent releases of coho and associated studies are occurring. Studies have been conducted to determine the impact of hatchery coho predation on salmonid fry in the Wenatchee and Yakima subbasins, the abundance of residual hatchery coho following volitional releases in the Methow, Wenatchee, and Yakima subbasins, the potential for Chinook redd superimposition by later spawning coho salmon, coho micro-habitat use and overlap by naturally spawned coho salmon, and carrying capacity. In addition, all juvenile coho salmon, to be released in the Wenatchee and Methow subbasins in 2002, have been successfully marked, enabling identification and quantification of future smolt and adult natural production. Project performance is evaluated annually through the Mid-Columbia Technical Workgroup to coordinate, expand, or adapt studies as data indicate is necessary. The scope, magnitude, and biological approach of the second phase will be determined by the results of the risk/feasibility phase.

Fish Species of Interest: Pacific Lamprey

(This section taken from Nass et al. 2002 in GCPUD 2003a)

Population Characterization and Habitat Relationships

The Pacific lamprey is an anadromous fish and is one of three species of lamprey found in the Columbia River. The other two are river lamprey (*L. ayresii*) and brook lamprey (*L. richardsoni*) (Wydoski and Whitney 1979). Lamprey are native to many of the tributaries of the lower Columbia (Jackson et al. 1997, Jackson et al. 1996) and the Snake River (Close and Bronson 2001, Close et al. 1995), but their distribution between Priest Rapids and Chief Joseph Dam is less certain. Pacific lamprey do not appear to have genetically different stocks (at least between some lower and mid-Columbia basins) (Powell and Faler 2001) or to have homing tendencies, but will stray to other locations (Hatch et al. 2001).

Pacific lamprey are long and snake-like in form and are poor swimmers utilizing an anguilliform swimming motion (Mesa et al. 2001). Burst swimming speed was calculated to be approximately 2.1 m/sec for lamprey (Bell 1990). On the Fraser River in British Columbia, lamprey were estimated to migrate 8 km/day (Beamish and Levings 1991). In the Columbia River, the lamprey were estimated to migrate 4.5 km/day (Kan 1975).

They have a disk-shaped funnel for a mouth, which juveniles use to filter feed on detritus and algae (Close et al. 2002) in backwaters and eddies. Adults are opportunistic feeders and prey on a variety of fish species in the ocean. They have a series of teeth at the center of the mouth disk to tear the skin of their prey. This mouth disk is also used during migration to conserve energy and move upstream against the flow; the lamprey swims in bursts, and then uses its mouth as a suction cup to attach to a surface and rest.

Distribution

Historical distribution of Pacific lamprey in the Columbia and Snake rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). It is likely that Pacific lamprey occurred historically throughout the Wenatchee, Entiat, Methow, and Okanogan basins. Within the Wenatchee River basin, Pacific lamprey would have occurred in the Wenatchee River, Chiwawa River, Nason Creek, Little Wenatchee River, White River, Icicle Creek, Peshastin Creek, and Mission Creek. In 1937, WDF (1938) collected several juvenile lamprey that were bypassed from irrigation ditches in Icicle and Peshastin creeks, and the lower Wenatchee River. Pacific lamprey would have used the Entiat and Mad rivers in the Entiat Basin and the Methow, Twisp, Chewuch, and Lost rivers, and Wolf and Early Winters creeks in the Methow Basin. In the Okanogan Basin, lamprey may have used the Okanogan River, Similkameen River, Salmon Creek, and Omak Creek.

Because Grand Coulee Dam was built without fish passage facilities, the Fish and Wildlife Service developed the Grand Coulee Fish Maintenance Project (GCFMP) (Fish and Hanavan 1948. Fish and Hanavan (1948) do not mention the capture of lamprey. Apparently these fish were allowed to pass Rock Island Dam.

The current distribution of Pacific lamprey in the Columbia River and tributaries extends to Chief Joseph Dam on the Columbia River and to Hells Canyon Dam on the Snake River (Close et al. 1995). Both dams lack fishways and exclude lamprey from large areas where they were assumed historically present Landlocked populations have been found (Wallace and Ball 1978), but they have not persisted. Beamish and Northcote (1989) concluded that metamorphosed landlocked lamprey were unableto survive to maturity. Within the CCP, the distribution of lamprey is not well known. They still exist in the Wenatchee, Entiat, and Methow systems, but the distributions within those systems are mostly unknown.

Migration

Pacific Lamprey spend 5 to 7 years in fresh water before they migrate to the ocean and transform from the larvae (ammocoete) stage to adults (Wydoski and Whitney 1979, Hart 1973). After metamorphosis in October and November, young adults migrate to the ocean between late fall and late spring (Close et al. 1995). Fyke net sampling at Wells Dam indicates that lamprey pass the dam during most months that sampling occurs, but the greatest numbers usually pass during April through July (BioAnalysts 2000a). Most pass Rocky Reach Dam in late May and June (CCPUD 1991).

Adult Pacific Lamprey spend 1.5 to 3.5 years in the Pacific Ocean (Beamish 1980 as cited in Close et al. 2002, Kan 1975) before returning to freshwater streams to spawn. At Bonneville Dam, the adult run begins in May and generally goes through October, peaking towards the end of June-mid July (Columbia River DART webpage). Beamish (1980) suggested lamprey enter fresh water between April and June, and complete migration into streams by September. It is not clear how flow impacts freshwater immigration.

Spawning

Pacific lamprey that migrate inland in the Columbia River spawn later than those in coastal streams (Close et al. 1995). Lamprey along the Oregon coast generally spawn in May at temperatures between 10° and 15°C. In the Columbia River basin, lamprey typically spawn during June and July (Wydoski and Whitney 1979; 2003). Kan (1975) collected both spawning and pre-spawning fish in the John Day River system in July. Mattson (1949) described lamprey spawning in the Willamette River during June and July. They probably spawn in the UMM Subbasin in June and July.

No one has documented the spawning sites selected by Pacific lamprey in the UMM Subbasin (BioAnalysts 2000a). They likely spawn in the lower reaches of the Wenatchee, Entiat, and Methow rivers. Lamprey may spawn in the Wenatchee River near Leavenworth (RM 23.9-26.4), because both adults and ammocoetes occur there. This area consists of well-sorted gravels and cobbles. Lamprey may also spawn in the Gunn Ditch near Monitor (K. Petersen, NOAA Fisheries, pers. comm., in Nass et al. 2002). Females lay between 35,000 and 100,000 eggs per nest and the adult lamprey die after spawning (Wydoski and Whitney 1979).

Population Status

Fish counts at Columbia River dams began in the 1930s, and lamprey were counted along with salmonids as they ascended to spawning grounds. In the first few years of counts at Bonneville Dam, lamprey counts were above 150,000. In the 1940s, counts ranged from approximately 50,000 to just under 150,000 (Close et al. 1995). In the late 1950s, counts rose dramatically to over 350,000 and then dropped to less than 50,000 in the mid 1990s.

There is little information on the abundance of Pacific lamprey in the upper Columbia region except counts of adults and juvinilles at dams and juvenile salmon traps. There are no estimates of redd counts or juvenile and adult counts in tributaries.

In the upper Columbia, large declines of adults occurred at most mainstem dams during the late 1960s and early 1970s (Close et al. 1995). During the period between about 1974 and 1993, adult lamprey counted at Rock Island Dam was quite low. Counts of adults have increased since that time; however, this increase corresponds with the start of both day and night counts (see below), which may have some effect on the comparison. Recent increases are greater than those in the last 10 (years, days, months, decacades?), suggesting that a true increase in abundance occurred.

In summary, while it is difficult to determine the historical abundance of lamprey in the Columbia Basin, and in the CCP, circumstantial evidence suggests that they have declined. Counts of juvenile and adult lamprey fluctuate widely. It is unknown whether these fluctuations represent inconsistent counting procedures, actual population fluctuations, or both. Although these factors may make actual comparisons difficult, it appears that lamprey in the upper Columbia are currently increasing.

Population Management

Hydroelectric

As part of the relicensing process, GCPUD began a multi-year research program to evaluate adult Pacific Lamprey passage at Priest Rapids and Wanapum dams using radiotelemetry techniques. Study results included (or will include?) evaluation of passage success, identification of factors that impede lamprey passage, and identification of passage improvements. A total of 51 and 74 fish were radio-tagged and released in the Priest Rapids Dam area in 2001 and 2002, respectively.

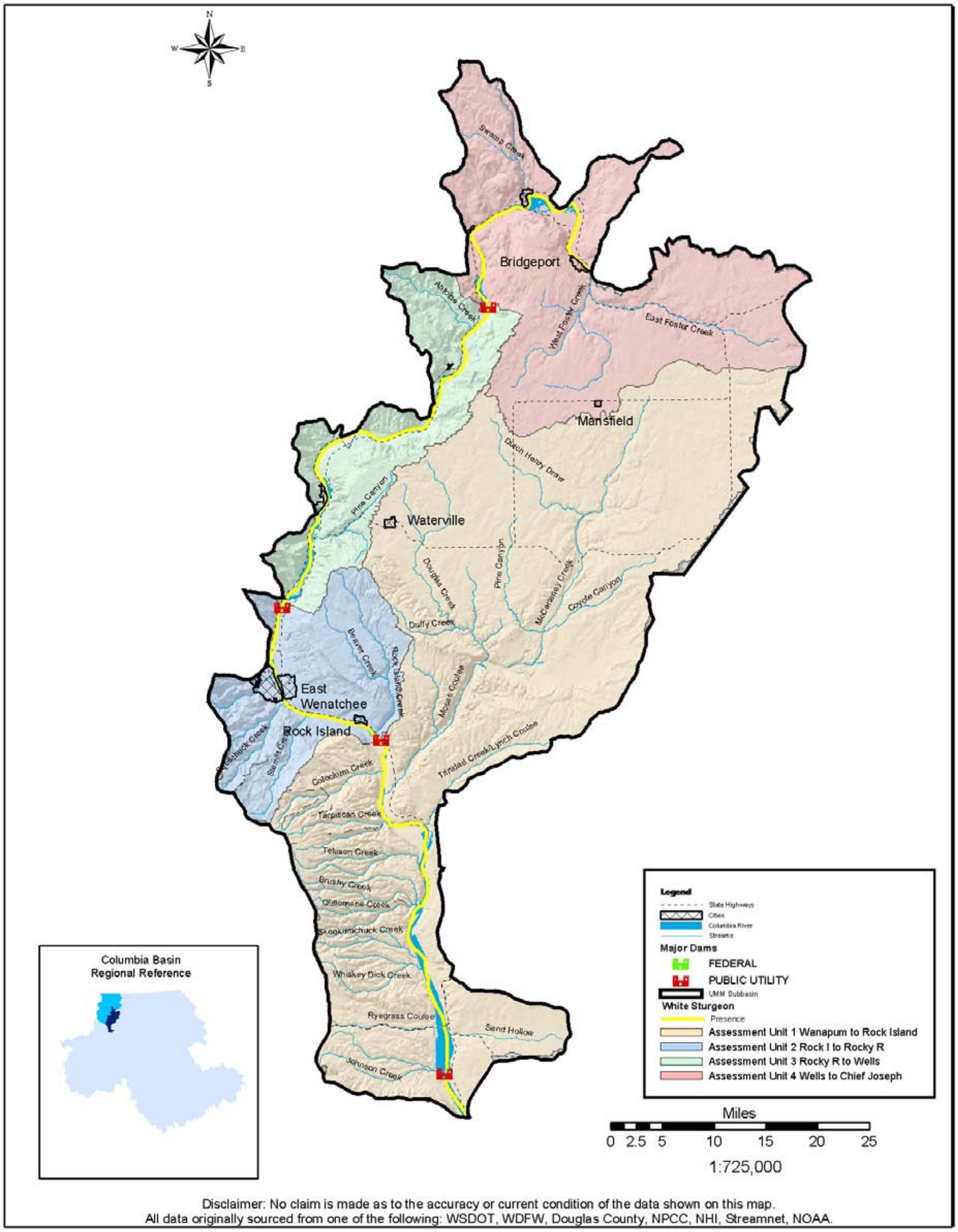
Harvest

The Pacific lamprey is reported to be an important fish of cultural, utilitarian, and ecological significance (Close et al. 2002). Close et al. (1995) reported that Native American tribes of the Pacific Coast and interior Columbia Basin harvested lamprey for subsistence, ceremonial, and medicinal purposes. In addition, a commercial fishery for lamprey also occurred during the 1940s, and was used as food for livestock and cultured fish.

Fish Species of Interest : White Sturgeon

Historically, white sturgeon moved throughout the mainstem Columbia River from the estuary to the headwaters, although passage was probably limited at times by large rapids and falls (Brannon and Setter 1992). Beginning in the 1930s, with construction of Rock Island, Grand Coulee, and Bonneville dams, migration was disrupted because sturgeon will apparently only pass downstream through fish ladders designed for salmon (S. Hays, pers. comm., in Peven 2003). Current populations in the Columbia River Basin can be divided into three groups: fish below the lowest dam, with access to the ocean; fish isolated (functionally but not genetically) between dams; and fish in several large tributaries. In the CCP, construction of Wells, Rocky Reach, Rock Island, and Wanapum Dam have disrupted upstream movement of sturgeon. Current White Sturgeon distribution is illustrated in Figure 27.

Construction of Columbia River dams may have created “isolated” populations of white sturgeon. However, the population dynamics and factors regulating production of white sturgeon within these “isolated” populations are poorly understood. Because of this lack of understanding, Douglas, Chelan, and Grant PUDs have instigated studies for white sturgeon through the re-licensing processes (Bickford, pers. comm., in Peven 2003; Golder Assoc. 2003 a, b). A better understanding of basic life history information, distribution and population sizes that currently exist within the CCP will result.



(DCTLS 2004)

Figure 27 White sturgeon distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Age structure and Sex Ratios

Sturgeon are known to live in excess of 100 years (Beamesderfer and Nigro 1995). The median age of maturity of lower Columbia River sturgeon is 24 years and 95% were mature between the ages of 16 and 35 years (Wydoski and Whitney 2003). This supports the data collected on fish in the Wanapum and Rocky Reach reservoirs of the CCP (Golder Assoc. 2003a, 2003b in GCPUD 2003a).

In recent studies by Golder Assoc. (2003a, b in GCPUD 2003a), ages of sturgeon sampled were estimated between 3-50 years. The younger age classes are indications of successful spawning in the CCP and emigration from upstream. For fish captured in the Wanapum and Rocky Reach reservoirs, the overall sex ratio was 1:1 (Golder Assoc. 2003a, b in GCPUD 2003a). Because of relatively small sample sizes, especially in the Rocky Reach reservoir, this may or may not be representative of the total population.

Length at age

Sturgeon can attain lengths of greater than 381 cm (12.5 feet; Wydoski and Whitney 2003). White sturgeon can reach sexual maturity at about 120 cm (4 feet) for males and 180 cm (6 feet) for females; however, most fish mature at a larger size (Wydoski and Whitney 2003).

In the CCP, sturgeon caught in the Wanapum and Rocky Reach reservoirs appeared to have two length modes; one roughly between 45-100 cm (1.5-3.3 feet) and the other from about 150-250 cm (5-8 feet; Golder Assoc. 2003a, 2003b in GCPUD 2003a). This supports the information presented in Wydoski and Whitney (2003), where white sturgeon throughout the west coast ranged from 48-81 cm (1.5-27 ft) for 5-year-old fish to 160-241 cm (5.3-8 ft) for 30 year old fish.

Migration

Sonic tagging studies show that white sturgeon are mostly inactive from late fall to spring (Golder Assoc. 2003a, 2003b in GCPUD 2003a). Spawning migration in the Wanapum Reservoir occurred between April and June. Since movement is limited by the dams, no large movements are believed to occur in the reservoirs of the CCP. Juvenile white sturgeon appear to migrate downstream during winter and early spring, and the movements are thought to be primarily to increase (Golder Assoc. 2003a in GCPUD 2003a).

Spawning

In the lower Columbia River, the spawning period extended from late April or early May through late June or early July of each year (McCabe and Tracy 1993). Spawning occurred primarily in the fast-flowing section of the river downstream from Bonneville Dam, at water temperatures ranging from 10 to 19 °C. Freshly fertilized white sturgeon eggs were collected at turbidities ranging from 2.2 to 11.5 NTU, near-bottom velocities ranging from 0.6 to 2.4 m/s, mean water column velocities ranging from 1.0 to 2.8 m/s, and depths ranging from 3 to 23 m. Bottom substrate in the spawning area sampled was primarily cobble and boulder. White sturgeon deposit their eggs by “broadcast” spawning. Mature white sturgeon commonly produce between 100 and 300 thousand eggs, although larger fish may produce up to 3 million eggs (Wydoski and Whitney 2003). Only a small percentage of white sturgeon spawn in a given year; spawning intervals are estimated at 3 to 11 years (Wydoski and Whitney 2003). No data has been collected in the CCP for fecundity of white sturgeon.

Spawning has been documented in the CCP only in the tailrace of Rock Island Dam (Golder Assoc. 2003a in GCPUD 2003a)., Indirect evidence of spawning in the Rocky Reach reservoir includes presence of the 1997 brood (Golder Assoc. 2003b in GCPUD 2003a), capture of juvenile sturgeon (84 cm in length and less then 3 kg in weight) (Chelan PUD, unpublished data, 2001), and a sturgeon less then 90 cm was observed during pikeminnow removal programs (Todd West, pers. comm., 2001). The sturgeon spawning migration begins in May in the Wanapum Dam reservoir when water temperatures are between 8-13 °C (Golder Assoc. 2003CPa), which is similar to spawning activities documented in the lower Columbia River (Wydoski and Whitney 2003).

Grant County PUD Project Area Study

White sturgeon populations in Priest Rapids and Wanapum reservoirs, on the middle Columbia River, were investigated from 2000 to 2002 as part of the Public Utility District No. 2 of Grant County's (GCPUD) hydroelectric project relicensing process (FERC No. 2114). Below is a summary of a comprehensive study that has been conducted on white sturgeon in the GCPUD Project area (Golder 2003b in GCPUD 2003a).

The population of white sturgeon (estimated between 398 and 881 individuals) in Wanapum Reservoir contained a relatively equal distribution of young and mature individuals. Approximately 20% of the total catch was composed of juvenile fish, which suggests that this population experiences natural recruitment or that the reservoir receives an influx of juveniles from upstream. Based on set line capture and sonic tag movement information, white sturgeon were distributed throughout the free-flowing portion of the reservoir upstream of Vantage Bridge (RM 421) to Rock Island Dam tailrace (RM 452). Wanapum Reservoir contained areas for feeding, spawning, and rearing; these areas were similar to habitats observed in reservoirs throughout the Columbia River and on the Snake River. Spawning velocities were found to be slightly lower than those observed in Priest Rapids Reservoir below Wanapum Dam, and were within optimal spawning velocities established for white sturgeon during wet water years as calculated by a habitat model (Batelle, unpublished data, 2001 in Golder 2003b).

During set line capture programs conducted in 2000 and 2001 in Wanapum Reservoir, white sturgeon ranged from 50 to 231 cm in fork length (FL), and 1 to 118 kg in weight. Juvenile/sub-adult fish were present in the sampled population. Length-frequency distributions of white sturgeon did not vary between study years. Surgical examination of captured individuals indicated that an equal proportion of males and females, was present in Wanapum Reservoir. These fish were of varying sex and maturation stages. Captured white sturgeon in Wanapum Reservoir ranged from age-4 to age-37, however intermediate aged fish were not well represented in the sampled population. Six fish were recaptured during the present study, and exhibited an increase in growth of approximately 6.8 cm per year.

In Wanapum Reservoir, 31 white sturgeon, 19 females, 11 males, one juvenile/subadult, and one of unknown sex and age, were implanted with sonic transmitters during capture sessions conducted in the spring and fall of each year. Movement information collected by boat-based surveys and remote telemetry stations indicated that sonic tagged white sturgeon were relatively inactive from September to May, and usually remained in one of four overwinter areas identified during the present study. Columbia Cliffs (RM 442) was identified as a very important overwinter area during the present study, since a large proportion of sonic tagged fish at-large resided at this location during this period.

Some fish were observed to move between overwinter areas throughout the duration of the overwinter period. In October and November, a few white sturgeon were also observed to move from the main overwinter area to the feeding area located near Whiskey Dick Creek (RM 426), likely to take advantage of the fall Chinook salmon that migrate during this time. One mature female that was implanted with a temperature and depth sensor (i.e., CHAT tag), moved into both deep and shallow habitats during the overwinter period, but these movements were not diurnal in nature.

During the spawning period, mature white sturgeon were observed to move upstream to the tailrace of Rock Island Dam in Wanapum Reservoir in early June, and most remained until late July. Short-term observations made on white sturgeon implanted with temperature and depth sensors indicated that one mature female moved into deep and shallow areas during the spawning period. These variations in depth were diurnal in nature and were more variable during the spawning season compared to the end of the overwinter period. Observations from another mature female also indicated that this fish was located in depths that were, on average, 10m shallower during the early spawning season compared to the overwinter period.

Spawning was detected in Wanapum Reservoir, below Rock Island Dam, during all three years of study. Newly spawned white sturgeon eggs were collected when water temperatures below Rock Island Dam were within suitable ranges for optimal development. Preliminary information indicated that larvae incubated *in situ* also hatched within the time required for normal embryo development. Spawning habitats below Rock Island Dam were similar to other white sturgeon habitats throughout the Columbia River, with the exception of slightly lower water velocity during dry and normal water years as calculated by the habitat model (Batelle, unpublished data, 2001 in Golder 2003b). The number of spawning events and egg catch-rates was highest in 2002 (i.e., seven events; 1.78 eggs/mat-day), followed by 2000 (i.e., five events; 0.06 eggs/mat-day), and 2001 (i.e., one event; 0.02 eggs/mat-day). The variability in the number of spawning events and egg catch-rates may be related to differences in discharge between years; 2001 was the second lowest discharge event recorded since the early 1960's.

Population Status

Historic abundance of white sturgeon within the CCP is not known. Grant, Chelan, and Douglas PUDs are currently gathering information on white sturgeon in the Columbia River, within the CCP, as required by existing licenses and re-licensing for their hydroelectric facilities.

In Wanapum Reservoir, Golder Assoc. (2003a in GCPUD 2003a) estimated the population at 351 (95% CI: 314-1,460) based on mark and recapture studies between 1999 and 2001. In the Rocky Reach Reservoir, Golder Assoc. (2003 b in GCPUD 2003a) estimated the population at 47 (95% CI: 23-237). There are no estimates for Rock Island Reservoir, and Douglas PUD is still collecting information for Wells Reservoir (S. Bickford, pers. comm.,).

While estimates of abundance have been obtained within the last few years in various sections of the Columbia River, baseline information is not available to determine if the population(s) are stable, increasing, or decreasing. However, it is reasonable to assume that the construction of the hydroprojects on the mainstem Columbia has significantly altered the population structure, and potentially the productivity of the white sturgeon population.

Population Management

Hatchery

Currently WDFW manages sturgeon solely through sport fishing regulations. No supplementation programs are present in the UMM. Sturgeon abundance has declined substantially since the Hydroelectric Dams were constructed. This decline is attributed to changes in fluvial characteristics of the river habitat and because the dams physically prevent movement up and down the river, precluding anadromy.

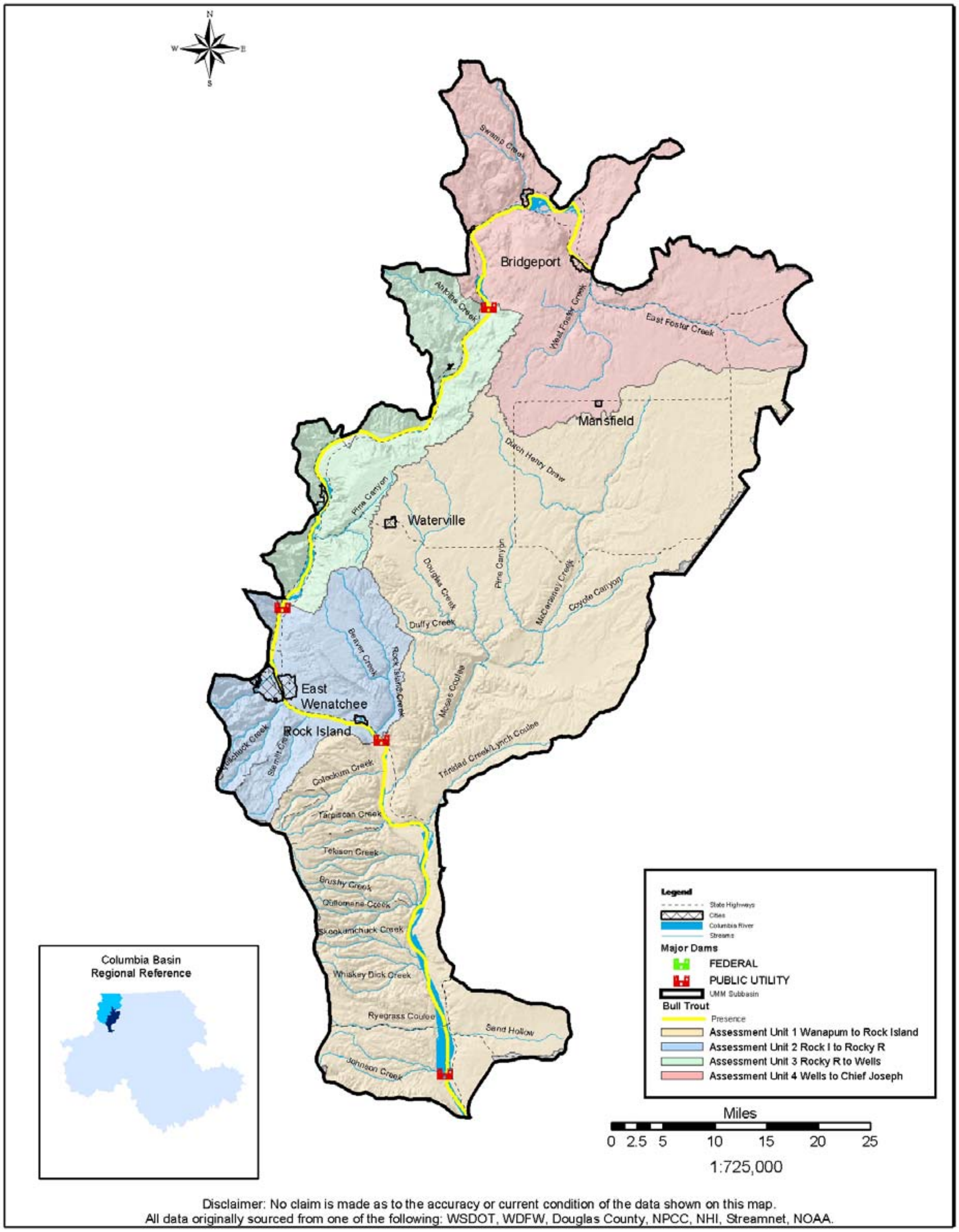
Sonic tagging studies shows that white sturgeon is mostly inactive from late fall to spring (Golder Associates 2003a, 2003b). Spawning migration in the Wanapum Reservoir occurred between April and June. Since the dams limit movement, no large movements are believed to occur between reservoirs of the UMM. Juvenile white sturgeon appears to migrate downstream during winter and early spring, the movements are thought to be primarily an attempt to migrate down river to the ocean (Golder Associates 2003CPa).

Hydroelectric

White sturgeon distribution has been affected by construction of Columbia River dams. What was believed to be a relatively continuous population, traveling throughout the Columbia River below barriers, is now a number of potentially disjunct populations between hydroelectric projects with only downstream movement of individuals. The biggest influence on the white sturgeon population(s) in the UMM Subbasin is the apparent upstream migratory blockage caused by the hydropower dams. As previously mentioned, this may be limiting the normal migratory ecotype and potentially affecting the productivity of the independent population(s) that occur in the UMM Subbasin.

Fish Species of Interest: Bull Trout

The Columbia River, from the Pacific Ocean at river kilometer (Rkm) 0 [river mile (Rm) 0] to Chief Joseph Dam at Rkm 877 (Rm545.1), has been proposed as critical habitat for the Columbia River Distinct Population Segment (DPS) of bull trout. Bull trout occur in greatest numbers in the upper Columbia River section of the proposed critical habitat reach where populations are larger and suitable conditions for foraging, overwintering, and migration occur (Figure 28).



(DCTLS 2004)

Figure 28 Bull trout distribution in the UMM Subbasin, WA.

Population Characterization and Habitat Relationships

Historically, there were most likely three life histories (or ecotypes) of bull trout within the CCP (adfluvial, fluvial, and non-migratory), with distribution and population levels dictated by temperature and gradient (Mullan et al. 1992a).

Distribution

Bull trout once filled most every cold-water niche in the tributaries of the CCP, except were the presence of natural barriers such as waterfalls or small stream size blocked access to headwater streams. While historic distribution in the CCP is difficult to determine (Rieman et al. 1997), The Columbia River, between Wanapum and Grand Coulee dams was likely a migration corridor, overwintering habitat, and foraging area for fluvial bull trout that spawned in the major tributary systems (BioAnalysts 2002a, b; FWS 2002; Brown 1992). Bull trout are believed to have been present in the, Methow, Lake Chelan, Entiat, Wenatchee, and possibly Okanogan river basins (Mongillo 1993, Brown 1992).

The FWS's Upper Columbia Recovery Unit Team (UCRUT) identified three independent populations of bull trout currently in the CCP. These core populations include the Wenatchee, Entiat, and Methow Rivers and their tributaries (FWS 2002). Based on survey data and professional judgment, the UCRUT also identified subpopulations of bull trout within each core area: six subpopulations in the Wenatchee, two in the Entiat, and eight in the Methow.

There is considerable evidence that bull trout use the UMM for foraging, overwintering, and migration. In recent years, a large number of migratory adults have been observed moving through the fish ladders at Rock Island, Rocky Reach, and Wells dams. Current radiotelemetry and radiotagging studies show that bull trout use the Columbia River during fall, winter, and spring and move to and from the Columbia River and tributaries, upstream and downstream within the Columbia River, and overwinter throughout the Columbia River from an area upsteam of Wells Dam (Bioanalyst 2002) to an area near Wanapum Dam (T. Dresser, pers. comm., 2001 in FWS 2004).

Age Structure

Bull trout normally reach sexual maturity in 4 to 7 years (reviewed in Platts et al. 1993) and feed on macroinvertebrates, crayfish, and juvenile salmon (FWS 2004). The size and age of bull trout at maturity depends upon life-history strategy (Platts et al. 1993). Non-migratory fish are usually smaller than migratory populations and may live up to 20 years (, Brown 1992, Mullan et al. 1992a).

Within the CCP, Mullan et al. 1992 report some populations that did not mature until 9 years of age in the Methow Basin. They found that headwater male bull trout (potentially non-migratory ecotype) in the Methow River began to mature at age 5, and were all mature by age 6. Females from the same area began to mature at age 7 and were all mature by age 9. Brown (1992) found that most migratory bull trout within the Wenatchee River basin were between 5 and 7 years old. The bull trout that Mullan et al. (2002b) found that did not mature until 9 years of age are the oldest (at first maturity) reported within the literature. The oldest bull trout sampled in the Methow River was 12 years (Mullan et al. 1992b).

Migration

Studies show patterns of long distance migrations (>225 km or 140 miles round trip), and extended over-wintering use (>6 months) of the Columbia River. Migrations of bull trout between the Columbia River and the Wenatchee, Entiat, and Methow rivers have been documented (FWS 2001, 2002, CCPUD 2002, BioAnalysts 2001). Bull trout have also been collected in the juvenile fish passage facilities at Rocky Reach and Rock Island dams (Fish Passage Center, *in litt.*).

A 3-year radio telemetry study was initiated in 2001 (BioAnalysts 2002a, b, 2003) to track bull trout movement within the CCP. A total of 79 bull trout were tagged in 2001 and 2002 (15, 45, and 19 fish at Rock Island, Rocky Reach, and Wells dams, respectively) during May and June. All of the tagged fish, despite their release location, migrated into the Wenatchee, Entiat, or Methow rivers, by the beginning of August, although most entered in June and July. Only one fish entered the Okanogan River; where it stayed briefly, then swam back downstream and entered the Methow River.

After entering tributaries, most bull trout remained there until October-November, when they migrated back to the Columbia River (BioAnalysts 2002a, b, 2003). This time period overlapped with spawning timing (see below) and most fish were presumed to have spawned within the tributary areas that they were in during August through October.

Once fish exited the tributaries, they migrated various distances both up- and downstream of the tributary confluences. Some bull trout held near the hatchery outfall at Wells Hatchery. Since temperatures were not greatly different from ambient Columbia River temperatures, it is assumed that fish were occupying this area for feeding opportunities, instead of seeking thermal refugia (BioAnalysts 2003, 2002).

As previously indicated, most bull trout pass counting windows at dams on the Columbia River during May and June (CCPUD, unpublished data, 2001). Diel timing of migration at the dams indicates that fish pass primarily during day light hours.

Migratory juveniles usually rear in natal streams for 1-4 years before emigration (Pratt 1992, Fraley and Shepard 1989, Goetz 1989). Methow Subbasin juvenile bull trout rear in the coldest headwater locations until they reach a size that allows them to compete with other fish (75-100 mm; Mullan et al. 1992b). Non-migratory forms above barrier falls probably contribute a limited amount of recruitment downstream, nevertheless, this recruitment contributes to fluvial and adfluvial productivity. The fluvial forms (e.g., Twisp River, Wolf Creek) migrate to the warmer Methow and Columbia rivers, while the adfluvial populations (e.g., Lake Creek, Cougar Lake) migrate to nearby lakes.

McPhail and Murray (1979) suggested two migration periods for juvenile bull trout: a spring migration of newly emerged fry, and a fall migration of larger age 1+ and 2+ fish. These fish may be migrating because of high flows (in the spring), or survival (thermal refugia) in the fall, which may be different than the “smolt” behavior of migratory fluvial or adfluvial fish. At Columbia River dams within the CCP, very low numbers of juvenile bull trout pass between April and August, primarily in June (CCPUD, unpublished data, 2001).

Spawning

Bull trout spawn between August and November in streams with cold, unpolluted water, clean gravel, cobble substrate, gentle stream slopes, and water temperatures ranging from 5-9 °C (Reiman and McIntyre 1993). Spawning areas are commonly associated with cold-water streams or areas where stream flow is influenced by groundwater. All bull trout life stages are associated with complex forms of cover including large woody debris, undercut banks, boulders, and pools.

Population Status

In the state of Washington, reductions of bull trout have primarily occurred in the eastern part of the state. It is unclear how many bull trout used the Columbia and Snake rivers, but fish are still observed in counting windows of dams, primarily in the Columbia, upstream of the confluence of the Snake (Rieman et al. 1997).

Rieman et al. (1997) listed 144 watersheds within the "Northern Cascades" that had bull trout present. Their classification of Northern Cascades includes watersheds south of the CCP, including the Yakima, White Salmon, and Kickitat basins. This is almost 50% of potential historic range, using their criteria. While this complicates their assessment of the streams within the CCP, they state that within the Northern Cascades, 10 populations are "strong," 22 are depressed, 90 were of unknown status, and 22 were transient (i.e., the watershed was used mostly as a migratory corridor; Rieman et al. 1997).

Estimates of abundance specific to the CCP were not available until recent years through redd counts (begun in the 1980s in the Wenatchee and Entiat basins, and the 1990s in the Methow Basin), and Columbia River dam counts. Since non-migratory fish are difficult to enumerate, all estimates of current abundance should be considered underestimates of the true population size of bull trout within the CCP. This is based on the belief that "non-migratory" fish are most likely contributing to the "migratory" populations, and potentially vice versa, although there may not be very many non-migratory bull trout populations within the CCP (MacDonald, pers. comm., in Peven 2003, Archibald and Johnson 2002).

Prior to 1998, fish counts at Rock Island and Rocky Reach dams did not differentiate bull trout from other resident trout. Since then, bull trout counts at Rock Island Dam have averaged 126, while at Rocky Reach and Wells dams, the fishway counts have averaged 250 and 120 bull trout, respectively. Bull trout counts have been lower at Rock Island Dam than at Rocky Reach Dam in all years from 1998 through 2002. This may be occurring because the major spawning areas are upstream of Rocky Reach Dam (Entiat and Methow basins), and only one between Rock Island and Rocky Reach (Wenatchee River).

Recent comprehensive redd surveys, coupled with preliminary radio telemetry work suggest that remaining spawning populations are not complete "genetic isolates" of one another, but rather co-mingle to some degree (Foster et al. 2002). Recent telemetry studies suggest that fluvial bull trout migrate between subbasins within the CCP (FWS 2002b, 2001). It is possible that there are separate, local spawning aggregates, but more monitoring and DNA analysis is necessary to be able to empirically determine this. Any independent subpopulations would most likely be found in headwater areas, upstream of barriers, within each subbasin. The barriers prevent immigration from downstream recruits, but not necessarily emigration to downstream areas during occasional high water events.

Population Management

Hydroelectric

While there are no physical barriers between each of the major tributaries and the Columbia River, the nine Columbia River dams may inhibit upstream migration and downstream passage of bull trout. These structures are equipped with passage facilities designed and operated primarily for upsteam and downstream passage of anadromous salmonids and not specifically for bull trout; therefore their degree of impact is uncertain. In the Upper Columbia, it appears bull trout move upstream and downstream between dams and tributaries without affecting the ability of the bull trout to reach spawning grounds (BioAnalysts 2002a, b, 2003). Bull trout have been observed in the fish ladders at Bonneville (Sprague, *in litt.*) and The Dalles dams (R. Cordie, pers. comm., in FWS 2004). Bull trout have never been officially recorded on Corps fish ladder counts even though fish counters may have observed them. Past records at the Lower Columbia River dams may not accurately represent bull trout passage because adult fish counts and juvenile fish monitoring ceased after October 31 and fish counters have not been instructed to record bull trout sightings. Bull trout have been observed passing the fish ladders at Wanapum, Rock Island, Rocky Reach, and Wells dams. These bull trout have been observed passing at similar or lower rates compared to salmon and steelhead through the ladders (Chuck Peven, pers. comm., in FWS 2004).

Downstream passage for juvenile anadromous fish is provided by fish passage facilities, by spilling water over dam spillways, or traveling through the powerhouse. Bonneville, John Day and McNary dams have fish screen and bypass facilities for juvenile anadromous salmonids. The Dalles Dam turbines are not screened and fish pass the dam through an ice-trash sluiceway. Fish pass the Upper Columbia projects via the spillways or similar passage devices. Wells Dam uses a hydrocombine which incorporates a spillway above the powerhouse. During the summer, fish that are collected at juvenile fish facilities at McNary Dam are transported by barge or truck and released at a site downstream from Bonneville Dam. It is uncertain if the juvenile fish facilities are effectively passing bull trout because these structures were designed for juvenile anadromous salmon and steelhead (FWS 2004). Only one bull trout has been officially recorded at the juvenile fish facilities at the Lower Columbia River dams. The fish was captured at the John Day Dam Smolt Monitoring Facility in May 2002 (R. Cordie, pers. comm., in FWS 2004). There is also a possibility that bull trout have not been recorded properly in the past at some of the smolt monitoring projects on the mainstem Snake and Columbia Rivers. Small numbers of juvenile and adult bull trout have been collected at the Rock Island Dam Smolt Monitoring Facility and at the Rocky Reach Dam surface collector (Fish Passage Center, *in litt.*).

While juvenile fish passage facilities were not specifically developed for the downstream passage of larger fish such as migrating steelhead kelts or adult bull trout, most systems have not shown injury or mortality to these life stages. However, a 40 to 50% injury rate has been measured in some years to adult salmonids passing through the juvenile fish bypass system at McNary Dam (Wagner and Hilson 1993, Wagner 1991). The overall efficiency of adult salmonids, including bull trout, passing through juvenile bypass facilities and spill has not been thoroughly examined (FWS 2004).

On December 20, 2000, the FWS issued a biological opinion to the Corps, BPA, and BOR (Action Agencies) on the effects of the Federal Columbia River Power System (FCRPS) on threatened and endangered species and their critical habitat. The four federal Lower Columbia

River dams are presently operating under this opinion, which includes four reasonable and prudent measures (RPM) to reduce the take of bull trout associated with operation of these projects. The RPMs are directed at determining the presence of and extent of bull trout use of the lower Columbia River within the FCRPS area, ensuring that bull trout passage is not impeded at FCPRS dams, preventing adverse impacts caused by FCPRS operations such as fish stranding, and reducing total dissolved gas caused by spilling at FCRPS dams to state standards. To implement the RPM's, the Action Agencies are required to do the following: 1) Count and record bull trout observed at the FCRPS lower Columbia River dams and those captured in field studies funded by the Action Agencies; 2) Cooperate in studies to determine the movements of bull trout from the Hood River and other tributaries into Bonneville Reservoir, to evaluate fluvial bull trout in the Klickitat River and potential habitat use in the White Salmon River following removal of Condit Dam; 3) Begin studies of the effect of flow fluctuations caused by FCRPS operations on bull trout or their prey 4) Initiate studies to determine the use and suitability of bull trout habitat in the lower Columbia River; 5) Investigate and implement, if appropriate, ways to reduce total dissolved gas production at FCRPS dams. These terms and conditions are directed to impacts on bull trout at the Lower Columbia River dams and do not specifically address habitat needs of bull trout in the Columbia River.

Conservation Actions

A number of federal, state, local, and tribal agencies and organizations are currently working on various programs, plans, and projects to protect and restore bull trout populations in the Columbia River Basin. Federal conservation actions include: (1) the development of the draft Bull Trout Recovery Plan (FWS 2002); (2) ongoing implementation of the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (USFS and BLM [PACFISH] 1994b) and the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH 1995); (3) ongoing implementation of the Northwest Forest Plan (USFS and BLM 1994a); (4) ongoing implementation of the Northwest Power and Conservation Council, Fish and Wildlife Program targeting subbasin planning; (5) ongoing implementation of the Federal Caucus Fish and Wildlife Plan; and, (6) ongoing implementation of Department of Agriculture Conservation Reserve Programs.

Conservation actions by the State of Washington include: (1) establishment of the Salmon Recovery Act (ESHB 2496) and Watershed Management Act (ESHB 2514) by the Washington State legislature to assist in funding and planning salmon recovery efforts; (2) abolition of a brook trout stocking in streams or lakes connected to bull trout-occupied waters; (3) changing angling regulations in Washington prohibit the harvest of bull trout, except for a few areas where stocks are considered "healthy"; (4) collecting and mapping updated information on bull trout distribution, spawning and rearing areas, and potential habitat; and, (5) adopting new emergency forest practice rules based on the "Forest and Fish Report" process. These rules address riparian areas, roads, steep slopes, and other elements of forest practices on non-federal lands.

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects that focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

Three of the Mid-Columbia River hydroelectric projects, Wells, Rocky Reach, and Rock Island, have requested FERC to include in their licenses HCPs under Section 10 of the ESA. Parties to these HCPs include the Chelan and Douglas county PUDs, the NMFS, FWS, WDFW and the Colville Tribes. This HCP includes operations and measures to address all anadromous fish that occur upstream of Rock Island Dam (not just ESA listed species). Bull trout will likely benefit from these HCPs, even though dam protection measures and habitat improvements are directed toward anadromous fish.

Ecologic Effects/Relationships (at subbasin scale)- Limiting Factors

The Upper Columbia DPS of bull trout was listed as threatened under ESA on June 10, 1998 (63 FR 31647). In the draft recovery plan (FWS 2002a), bull trout were grouped into DPSs, recovery units, core areas or local populations (see above). They defined core areas as composed of one or more local populations, recovery units are composed of one or more core areas, and a distinct population segment is composed of one or more recovery units. The manner in which bull trout were grouped in the recovery plan represents an adaptive comparison of genetic population structure and management considerations.

4.1.5 Limiting Factors

Five Dams are located within the UMM Subbasin: Wanapum, Rock Island, Rocky Reach, Wells, and Chief Joseph. These dams are run-of-the-river hydroelectric facilities and have no significant water storage capacity (CCPUD 2003). All of the projects except Chief Joseph Dam incorporate features to assist fish in their upstream and downstream passage. Three ladders assist adult fish on their return upriver to spawning grounds in the Columbia River tributaries.

At Rock Island, testing of conventional turbine intake screens at the First Powerhouse occurred between 1992 and 1995. Testing was suspended after researchers concluded that high intake velocities were trapping some juvenile fish against the screens, causing injuries and death. Now, shallow spills are being used to meet the survival standards of the HCP. Openings or notches have been installed in nine spillgates (CCPUD 2003).

Extensive monitoring occurred in 1999 for total dissolved gases in the tailrace at Rock Island. Waterways Experimental Station, a division of the U.S. Army Corps of Engineers, placed monitors in the water in numerous locations to take readings on total dissolved gases. This was designed to help biologists and engineers determine whether operational changes for spill can reduce total dissolved gas levels or if the placement of abatement structures, such as concrete deflectors that reduce the depth that spill plunges to in the tailrace, are required (CCPUD 2003).

A combination of factors have negatively impacted the viability of focal species and species of interest within the UMM Subbasin. These include, residential development and urbanization, road construction and maintenance, mining, grazing, hydropower development and water diversions, forest management, fish management (hatcheries and harvest regulations); entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and exotic species. The affects of these actions is to degrade and fragment fish and wildlife habitat, and block fish passage.

Hatchery

General

The only direct Columbia River releases of hatchery fish between the Wanapum Dam forebay and the Chief Joseph Tailrace occur from the Turtle Rock Ponds near Rocky Reach Dam and at Wells Hatchery immediately downstream of Wells Dam. Competition between hatchery and wild juveniles may occur where food and space requirements overlap. Impacts may be highest at hatchery release sites where large concentrations of hatchery fish can overwhelm the capacity of the immediate environment (CCPUD 1998). Impacts are assumed to diminish downstream as the hatchery fish disperse. The impact from large releases of hatchery fish on wild fish may be exacerbated by hatchery fish deficiencies in foraging and habitat selection behaviors. Thus, competition may drop as the hatchery fish disperse, adapt to their environment and learn to forage for natural food. Little data exists for evaluating adverse behavior effects of hatchery fish on wild fish in the Columbia basin, however one study presents evidence that larger hatchery juvenile Chinook pulled smaller wild Chinook with them as they migrated downstream (CCPUD 1998, BPA et al. 1994) and resulted in excessive predation by other fish on the smaller wild Chinook.

Increased migration time caused by the reservoirs could increase competition for available food supply between emigrating juvenile hatchery and wild Chinook and expose Chinook to increased predation, particularly by northern pike minnow. Predation risks to hatchery Chinook juveniles posed by coho, steelhead, and other Chinook stocks are unknown (SIWG 1984). Large concentrations of migrating hatchery fish may attract predators (e.g., birds, fish, and seals) and consequently contribute indirectly to predation of listed wild fish (Steward and Bjornn 1990). The presence of large numbers of hatchery fish may also alter wild salmonid behavioral patterns, potentially influencing their vulnerability and susceptibility to predation.

Differences in release timing for hatchery stocks could diminish competition (CCPUD 1998). Hatchery releases of summer/fall Chinook may also have positive ecologic impacts on other species. Increased numbers of Chinook and other salmonid species that escape to spawn in upper Columbia River tributaries may contribute nutrients to the system upon dying. In addition, releasing a mass of summer/fall Chinook juveniles from a WDFW hatchery may benefit co-occurring wild salmonid populations by overwhelming established predator populations.

Summer / Fall Chinook

Chapman et al. (1994a) estimated that only about 6 percent of the summer and fall run fish are of hatchery origin. There are no known genotypic, phenotypic, or behavioral differences between the hatchery stocks and natural stocks in the target area.

The ocean-type Chinook salmon in the UMM is one of the most electrophoretically homogenous populations in the state (BAMP 1998). Ocean-type Chinook in the region are genetically distinct from lower Columbia River ocean-type populations (Myers et al. 1998). Hatchery manipulations, post-GCFMP and in recent years, have lead to the mixing of summer/fall Chinook from various parts within the upper Columbia River region (Chapman et al. 1994b). This mixing, and/or homogenization that occurred through the GCFMP, may be responsible for the inability of electrophoretic analysis to differentiate among components of the Upper Columbia River summer/fall Chinook ESU (Chapman et al. 1994b).

The collection of summer/fall Chinook from the Wenatchee and Methow/Okanogan natural runs for use as broodstock is not expected to adversely affect the population status of the natural population relative to critical and viable thresholds. The effects of the broodstock collection program on the timing of spawning and on the composition of the spawning population (e.g., hatchery versus wild origin, age class distribution, sex ratios) are presently unknown, but are being determined through monitoring and evaluation projects underway. The percentage of non-indigenous stocks incorporated into the hatchery programs has been low (about 3 % of the over 200 million ocean-type Chinook propagated since 1941), and does not appear to have had a significant impact on the genetic integrity of the ESU (Chapman et al. 1994b, Myers et al. 1998).

There are, however, some uncertainties in the incubation and rearing protocols. Subbasin planners are unsure whether the release of ocean-type Chinook salmon into the tributaries impose deleterious ecological effects upon natural fish and whether the increasing incidence of "reservoir-reared" juveniles (Petersen and Murdoch 1998) is related to or simply because of changes in river hydrology from hydroelectric development.

Hydroelectric

Salmon and Steelhead

Salmon and steelhead migrating through the UMM are affected by mid-Columbia PUD project operations. The projects are operated as run-of-the-river facilities, with reservoirs that have rapid flushing rates and no thermal stratification during summer. Rapid water exchange and steep, sparsely vegetated shorelines limit juvenile steelhead rearing habitat. Transformation of the Columbia River into a series of reservoirs also altered the food webs that support juvenile salmonids and steelhead. Food available in the UMM reservoirs typically provides lower amounts of energy levels than that found in free-flowing areas such as the Hanford Reach (MCMCP 1995). Reduced productivity in the reservoir may affect feeding efficiency of fishes (Rondorf and Gray 1987).

Migrating juvenile salmonids and steelhead are also exposed to predation as they migrate through the UMM. Changes in physical habitat, water quality, and downstream passage conditions because of construction and operation of hydropower facilities have combined to increase the abundance of predators and the risk of juvenile outmigrant mortality because of predation (Chapman et al. 1994a). Studies of upriver migration confirm that hydro projects do not delay the return trip of adult salmon to their spawning grounds (CCPUD 2003).

Summer/Fall Chinook

Grant County PUD, through a contract with Battelle examined how summer/fall Chinook salmon and their habitat are influenced by the operation of the Priest Rapids Project (PRP) on the mid-Columbia River over a 3-year period (GCPUD 2003b). The research encompassed all aspects of the freshwater life stages of summer/fall Chinook salmon that take place within the PRP area (i.e., Columbia River from Priest Rapids Dam upstream to the tailrace of Rock Island Dam).

Specific research efforts related to the juvenile life stages included abundance, distribution, growth, and production, microhabitat use and availability, and survival studies. Adult life stage efforts included escapement and spawning in 2000, 2001, and 2002, spawning activity versus daylight and flow below Wanapum Dam, spawning habitat suitability in the Wanapum Dam tailrace and Priest Rapids Pool, and feasibility of monitoring fallback at Priest Rapids Dam using an acoustic camera.

The findings of the study show that juvenile sub-yearling Chinook salmon are produced in, rear in, and pass through the PRP, primarily rearing in the Wanapum Pool. The abundance of sub-yearling Chinook salmon, typically increased from mid-March through late May and then declined in June as the fish grew larger and moved offshore.

Chinook salmon in the PRP tend to use relatively shallow, warm, slow areas along the river/reservoir margins (e.g., island and bar areas, and sloughs) for early rearing habitat. The total area of the PRP that was suitable for early rearing habitat for sub-yearling Chinook was between 352 and 472 ha., and decreased with increasing discharge. At median discharge (Q50 = 154 kcfs), 2.93 percent of the area in Wanapum Pool was classified as suitable habitat for early rearing sub-yearling Chinook salmon.

Survival of sub-yearling Chinook salmon was determined for Wanapum and Priest Rapids dams by releasing paired replicates of PIT-tagged hatchery-origin sub-yearling Chinook salmon in 2001 and 2002.The survival of PIT-tagged sub-yearling Chinook salmon passing Wanapum Dam was 90 percent in 2001 and 93% in 2002 (GCPUD 2003a). In 2001 and 2002, PIT tags from this study were recovered from a tern colony on Solstice Island in Potholes Reservoir, 56 (64% from Wanapum Dam forebay releases) and 22 (no obvious trend relative to release location) respectively. Sixty-four percent of the 2001 tags were from releases made in the Wanapum Dam forebay.

Thirty-five redds were estimated to be constructed by fall Chinook salmon in a deepwater (9 to 11m) spawning area in the center of the river channel downstream of the railroad trestle (rkm 663) in 2001 and an estimated 66 redds were located in two deep water spawning areas in 2002. No redds were observed in 2000 or 2001 in the Rock Island Dam tailrace area. The use of side channels by spawning adult fall Chinook salmon was higher in 2000 and 2002, when mean daily discharge and escapement were higher than in 2001.

Pacific Lamprey

The study of adult lamprey migration patterns past dams and through reservoirs in the lower Columbia River have provided the first data sets on lamprey passage timing, travel times, and passage success at hydroelectric projects (Moser et al. 2002a, Moser et al. 2002b, Ocker et al. 2001, Vella et al. 2001). These studies have shown that approximately 90% of the radio-tagged lamprey released, migrate upstream and get detected at Bonneville Dam; however, less than 50% of the lamprey which encounter an entrance actually pass the dam. The primary reasons for relatively poor passage success are thought to be the lack of appropriate attachment sites in the high velocity areas and the high intensity lighting used at counting stations. Other factors that may affect passage include degree of sexual maturity in migrants, water flow velocities over 2 m/s, and fishway channel configuration and structure.

In the studies conducted at Priest Rapids Dam, radio-tagged lamprey passage success rates of 30% and 70% occurred in 2001 and 2002, respectively. At Wanapum Dam, radio-tagged lamprey passage success rates of 100% and 51% occurred in 2001 and 2002, respectively. A large proportion of lamprey never entered the fishway (Nass et al. 2002 in GCPUD 2003a).

Bull Trout

The nine Columbia River dams may inhibit upstream and downstream movement of bull trout in the Columbia River. However, the extent to which some of these structures inhibit bull trout migrations is unknown. Recent data suggests that bull trout move upstream at similar rates as anadromous salmonids (Chuck Peven, pers. comm., in FWS 2004).

Harvest

Estimation of recent, past harvest rates for summer/fall Chinook originating in the region is complicated by changes in timing of the adult return of the Wells Hatchery group. As a consequence, Chapman et al. (1994b) used only one brood year (1977) as the base for estimating preterminal exploitation rates for all subsequent brood years. The recent past (1975-87) mean exploitation rate for Wells Hatchery-origin summer/fall Chinook was estimated by Chapman et al. (1994b) to be about 40 %. The 1982-89 brood year average ocean fisheries exploitation rate is 39 %, with a total exploitation rate of 68 % estimated for the same years (Myers et al. 1998). Given fishery protection measures implemented in the preterminal area, Columbia River, and upper river tributaries to protect ESA-listed and depressed salmonid populations, future harvest rates on fish propagated by the program and on natural populations in the target area are expected to be lower than the mean level (40 %) estimated for the 1975-87 period. Ceremonial and subsistence fisheries by the Colville Tribe in waters upstream of Rock Island Dam (mainly at the base of Chief Joseph Dam) harvest an average of 800 summer/ fall Chinook adults each year (1987-92 data from Chapman and al. 1994b).

4.2 Environmental Conditions

4.2.1 Introduction

The process used to develop fish and wildlife assessments and management plan objectives and strategies is based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Ecoregion scale with attention to size and condition of core areas (subbasin scale), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most fish and wildlife populations extend beyond subbasin or other political boundaries, this “conservation network” must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal fish and wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of fish and wildlife resources.

In response to this need, Ecoregion planners approached subbasin planning at two scales. The landscape scale emphasizes focal habitats and associated species assemblages that are important to Ecoregion wildlife managers while specific focal habitat and/or species needs are identified at the subbasin level.

Ecoregion and subbasin planners agreed with Lambeck (1997) who proposed that species requirements (umbrella species concept) could be used to guide ecosystem management. The main premise is that the requirements of a demanding species assemblage encapsulate those of many co-occurring less demanding species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage should provide life requisite needs for most other focal habitat obligate species.

Ecoregion/subbasin planners also assumed that by focusing resources on selected terrestrial (riparian wetland, herbaceous wetland, shrub-steppe) and aquatic (Columbia River and small tributaries) habitats, the needs of most listed and managed fish and wildlife species dependent on these habitats would be addressed during this planning period.

4.2.2 Terrestrial/Wildlife Habitat

Wildlife Habitat Assessment Methods

The wildlife assessment was developed from a variety of "tools" including subbasin summaries, the Interactive Biodiversity Information System (IBIS), WDFW Priority Habitats and Species (PHS) database, Washington GAP Analysis database, Partners in Flight (PIF) information, National Wetland Inventory maps, Ecoregion Conservation Assessment (ECA) analyses, and input from local state, federal, and tribal wildlife managers. Specific information about these data sources is located in Appendix A of Ashley and Stovall (2004).

Interactive Biodiversity Information System (IBIS)

IBIS is an informational resource developed by the Northwest Habitat Institute (NHI) to promote the conservation of Northwest fish, wildlife, and their habitats through education and the distribution of timely, peer-reviewed scientific data.

IBIS contains extensive information about Pacific Northwest fish, wildlife, and their habitats, but more noteworthy, IBIS attempts to reveal and analyze the relationships among these species and their habitats. NHI hopes to make the IBIS web site a place where students, scientists, resource managers or any other interested user can discover and analyze these relationships without having to purchase special software (e.g. geographic information systems) or hassle with the integration of disparate data sets. IBIS will, however, provide downloadable data for users who desire to perform more advanced analyses or to integrate their own data sets with IBIS data. Finally, NHI sees IBIS not only as a fish, wildlife, and habitat information distribution system but also as a peer-review system for species data. NHI acknowledges that in a system as extensive as IBIS, there are going to be errors as well as disagreement among scientists regarding the attributes of species and their relationships. NHI encourages IBIS users to provide feedback in order to correct errors and resolve discrepancies.

The IBIS web site is in the early stages of development, however, NHI staff, with the support of many project partners, has been developing the data for over five years. The IBIS database was initially developed by NHI for Oregon and Washington during the Wildlife-Habitat Types in Oregon and Washington project. IBIS data is currently being refined and extended to include all of Idaho, Oregon, Washington, and the Columbia River Basin portions of Montana, Nevada, Utah and Wyoming. IBIS will eventually include species range maps, wildlife-habitat maps, extensive species-habitat data queries, and interactive wildlife-habitat mapping applications allowing dynamic spatial queries for the entire Pacific Northwest as previously defined.

Although IBIS is a useful assessment tool for some purposes, the current IBIS wildlife habitat maps have a minimum polygon size of 250 acres (O'Neil, pers. comm., 2003 in Ashley and Stovall, unpub. rpt., 2004). This polygon size results in under representation of linear aquatic, riparian, wetland, subalpine, alpine habitats and small patchy habitats that occur at or near the canopy edge of forested habitats. It is also likely that microhabitats located in small patches (e.g., herbaceous wetlands) or narrow corridors were not mapped at all. However, relatively continuous habitat types or fragmented habitats that occur in large blocks are better represented (e.g., shrubsteppe, agriculture). The historic IBIS wildlife habitat maps with a minimum polygon size of 1 km^2 are even more limited in accurately representing habitats that are located in small patches or narrow corridors. Habitat types that may be substantially underrepresented on these maps include herbaceous wetlands, montane coniferous wetlands, interior riparian wetlands, upland aspen forest, alpine and subalpine habitats, and small aquatic habitats such as lakes, rivers, and ponds (O'Neil, pers. comm., 2003 in Ashley and Stovall, unpub. rpt., 2003).

Another limitation of IBIS data is that they do not reflect habitat quality nor do they associate habitat elements (key ecological correlates [KECs]) with specific areas. As a result, a given habitat type may be accurately depicted on IBIS map products, but may be lacking quality and functionality. For example, IBIS data do not distinguish between shrubsteppe habitat dominated by introduced weed species and pristine shrubsteppe habitat.

Planners recognized the assumptions and limitations of the IBIS analysis. For those habitat types that are well represented, the data provide a good indication of the trends in habitat abundance and distribution from the historic to current condition (e.g., shrubsteppe) and IBIS data was used in the Assessment. Where IBIS data was most suspect of under representing habitat types, habitat quantifications were describes as "unknown" or alternate sources of data were used.

Washington State GAP

Washington State GAP data were also used extensively throughout the wildlife assessment. The GAP-generated acreage figures may differ from IBIS acreage figures as an artifact of using two different data sources. The differences, however, are relatively small (less than five percent) and will not impact planning and/or management decisions.

Ecoregion Conservation Assessment (ECA)

The ECA spatial analysis is a relatively new terrestrial habitat assessment tool developed by The Nature Conservancy (TNC). The ECA has not been completed in all areas within the greater Columbia River Basin. Where possible, however, WDFW integrated ECA outputs into province and subbasin plans. The major contribution of ECA is the spatial identification of priority areas where conservation strategies should be implemented. ECA products were reviewed and modified as needed by local wildlife area managers and subbasin planners.

Vegetation Zones

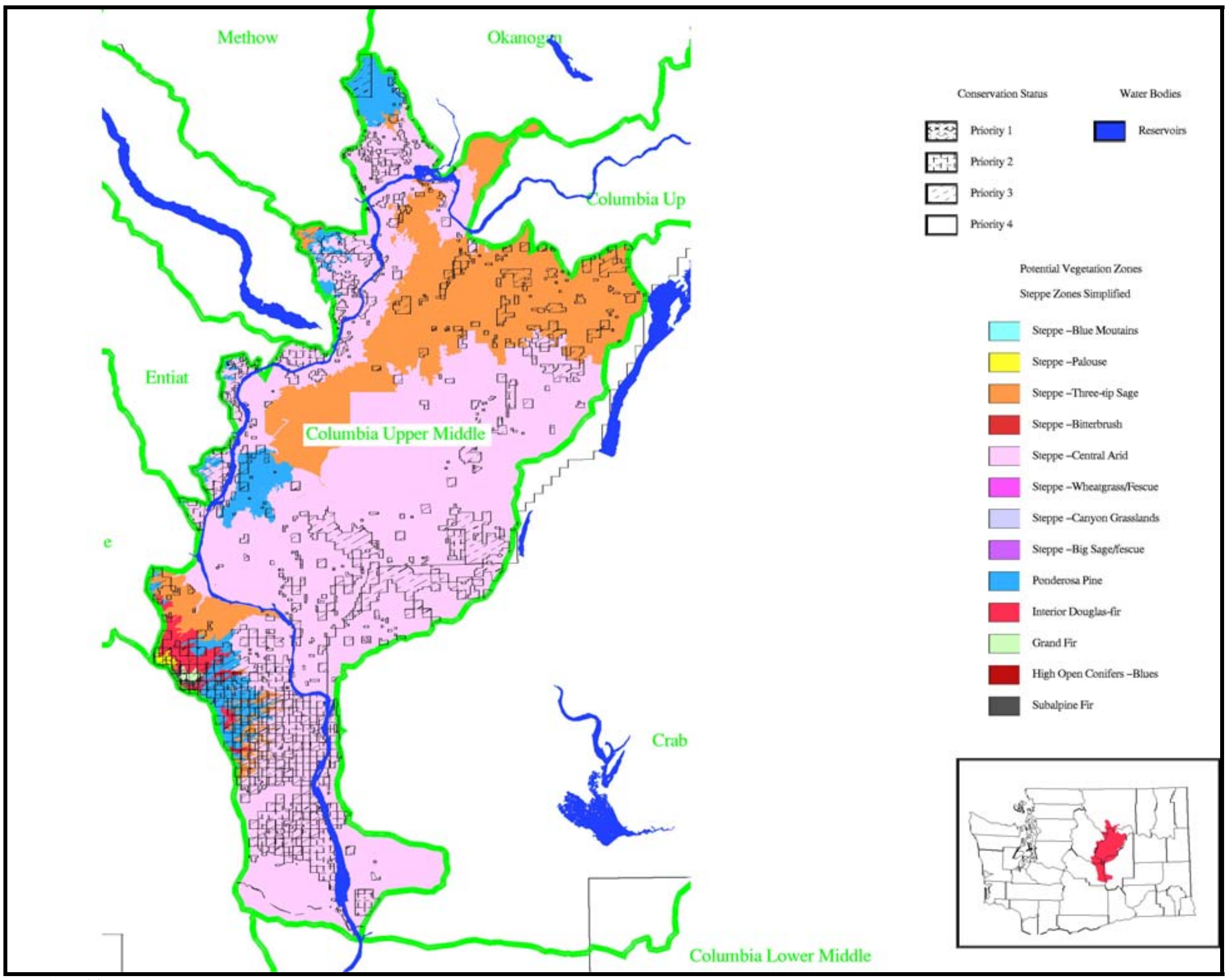
Cassidy (1997) identified seven historic (potential) vegetation zones that occur within the Subbasin (**Table 14**). The three-tip sage and central arid steppe vegetation zones are described in detail in Ashley and Stovall (unpub. rpt., 2004). These vegetation zones constitute focal habitat types. Alpine parkland, grand fir, ponderosa pine and Douglas fir are not focal habitat types, but occur in the far western portion of the Subbasin.

Vegetation zone status is summarized in Table 14. An estimated 18 percent of central arid steppe and 6 percent of three-tip sage has been lost to agriculture. Similarly, 2 percent of the ponderosa pine vegetation zone has been converted to agriculture.

Table 14 Historic and current extent of GAP vegetation zones in the UMM Subbasin, WA.

Status	GAP Vegetation Zone (acres)						
	Alpine Parkland	Subalpine Fir	Grand Fir	Douglas-fir	Ponderosa pine	Central Arid Steppe	Three-tip Sage
Historic (Potential)	1,629	2,203	1,580	21,214	89,116	1,111,686	380,155
Agriculture	0	0	0	0	523	366,762	186,254
CRP	0	0	0	0	0	22,348	48,048
Current	1,629	2,203	1,580	21,214	88,593	722,576	145,853

(Cassidy 1997)



(Cassidy 1997).

Figure 29 Protection status and vegetation zones of the UMM Subbasin, WA.

Noxious Weeds

Changes in biodiversity have been closely associated with changes in land use. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed." Twenty-six species of noxious weeds occur in the Subbasin (Table 15).

Table 15 Noxious weeds in the UMM Subbasin and their origin

Common Name	Scientific Name	Origin
Field bindweed	*Convolvulus arvensis*	Eurasia
Buffalobur nightshade	*Solanum rostratum*	Native to the Great Plains of the U.S
Common crupina	*Crupina vulgaris*	Eastern Mediterranean region
Jointed goatgrass	*Aegilops cylindrica*	Southern Europe and western Asia
Poison hemlock	*Conium maculatum*	Europe
Johnsongrass	*Sorghum halepense*	Mediterranean
Diffuse knapweed	*Centaurea diffusa*	Eurasia
Russian knapweed	*Acroptilon repens*	Southern Russia and Asia
Spotted knapweed	*Centaurea bibersteinii*	Europe
Purple loosestrife	*Lythrum salicaria*	Europe
Silverleaf nightshade	*Solanum elaeagnifolium*	Central United States
Puncturevine	*Tribulus terrestris*	Europe
Tansy ragwort	*Senecio jacobaea*	Eurasia
Rush skeletonweed	*Chondrilla juncea*	Eurasia
Leafy spurge	*Euphorbia esula*	Eurasia
Yellow star thistle	*Centaurea solstitialis*	Mediterranean and Asia
Canadian thistle	*Cirsium arvense*	Eurasia
Musk thistle	*Carduus nutans*	Eurasia
Scotch cottonthistle	*Onopordum acanthium*	Europe
Dalmatian toadflax	*Linaria dalmatica*	Mediterranean
Yellow toadflax	*Linaria vulgaris*	Europe

(Callahan and Miller 1994)

Subbasin Habitat Types

The UMM Subbasin consists of 15 wildlife habitat types, which are briefly described in Table 16. Detailed descriptions of these habitat types can be found in Appendix B of Ashley and Stovall (unpub. rpt., 2004).

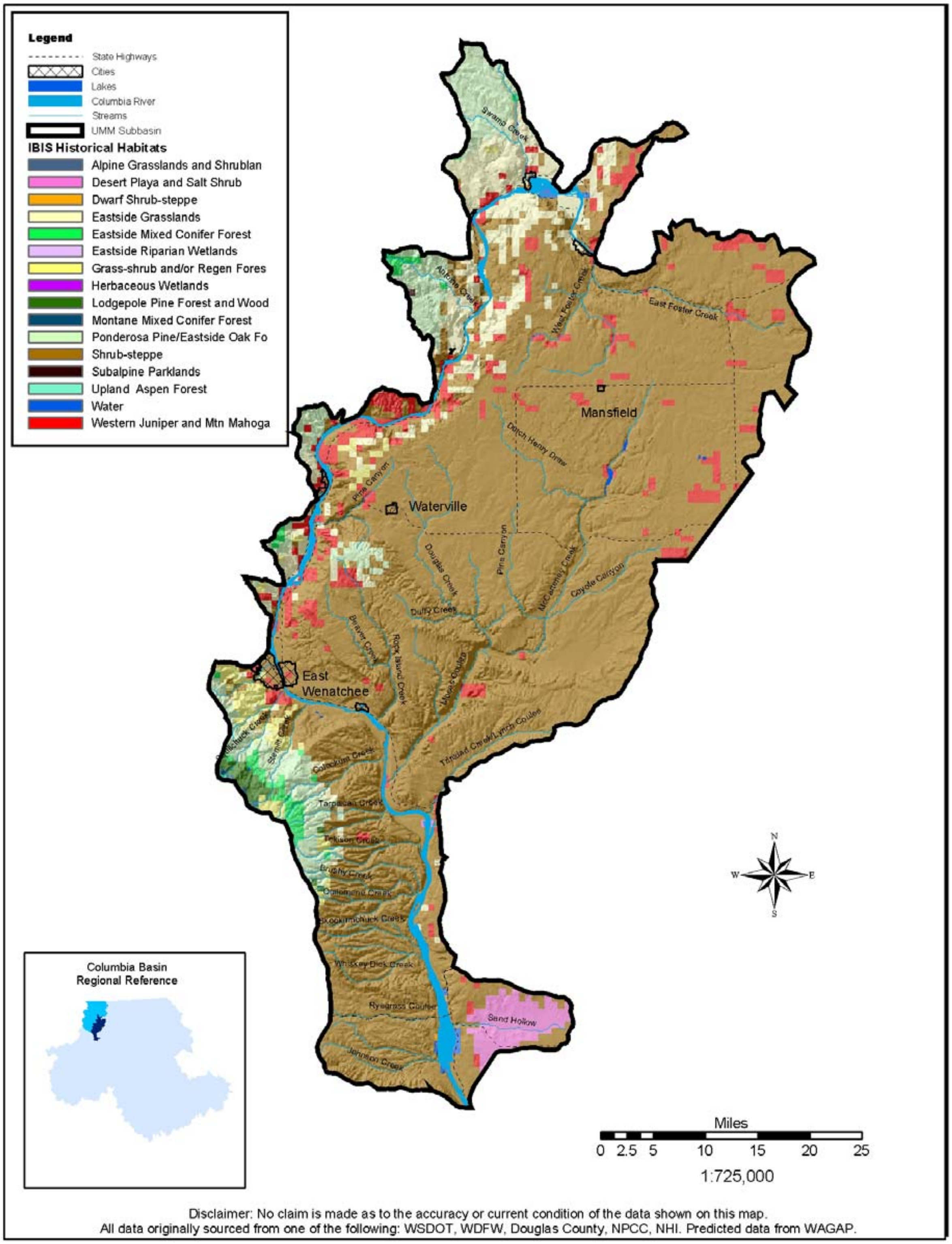
Dramatic changes in wildlife habitat have occurred throughout the Subbasin since pre-European settlement (circa 1850) (Figure 30 and Figure 31). The most significant habitat losses include the loss of 39 percent of shrubsteppe habitat. Quantitative changes in all Subbasin wildlife habitat types are compared in Figure 31 Current wildlife habitat types of the UMM Subbasin, WA.

Table 17.

Table 16 Current wildlife habitat types within the UMM Subbasin, WA.

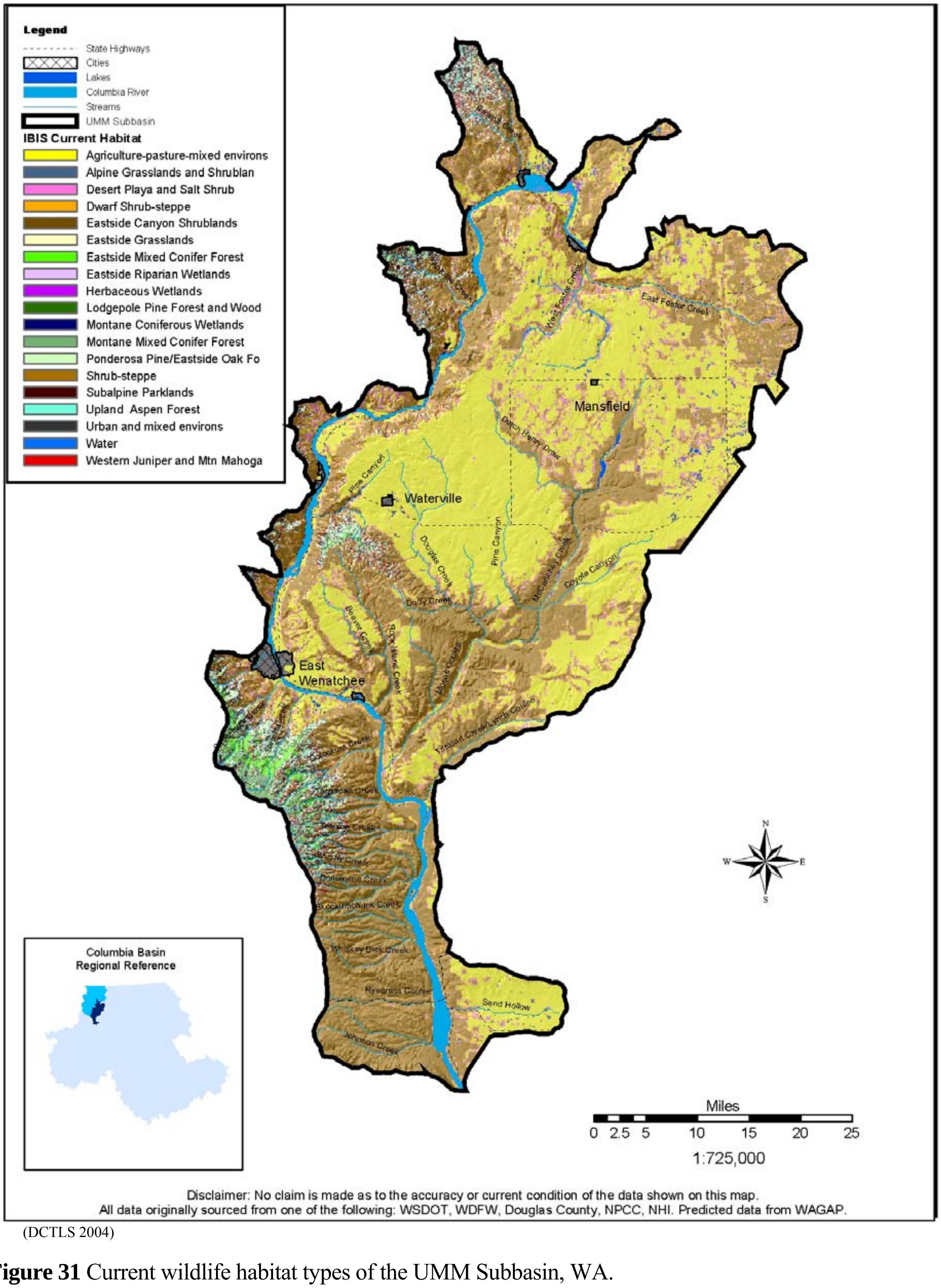
Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack, several species of conifer, understory typically shrub-dominated.
Eastside (Interior) Mixed Conifer Forest	Coniferous forests and woodlands, Douglas-fir commonly present, up to 8 other conifer species present, understory shrub and grass/forb layers typical, mid-montane.
Lodgepole Pine Forest and Woodlands	Lodgepole pine dominated woodlands and forests, understory, various mid- to high elevations.
Ponderosa Pine and Interior White Oak Forest and Woodland	Ponderosa pine dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass understory; lower elevation forest above steppe, shrubsteppe.
Upland Aspen Forest	Quaking aspen (*Populus tremuloides*) is the characteristic and dominant tree in this habitat. Scattered ponderosa pine (Pinus ponderosa) or Douglas-fir (Pseudotsuga menziesii) may be present.
Subalpine Parkland	Coniferous forest of subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and lodgepole pine (Pinus contorta).
Alpine Grasslands and Shrublands	This habitat is dominated by grassland, dwarf-shrubland (mostly *Evergreen microphyllous*), or forbs.
Eastside (Interior) Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogam crust.
Shrubsteppe	Sagebrush and/or bitterbrush dominated; bunchgrass understory with forbs, cryptogam crust.
Agriculture, Pasture, and Mixed Environs	Cropland, orchards, vineyards, nurseries, pastures, and grasslands modified by heavy grazing; associated structures.
Urban and Mixed Environs	High, medium, and low (10-29 percent impervious ground) density development.
Open Water – Lakes, Rivers, and Streams	Lakes, are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin Eastside Riparian Wetlands and Herbaceous Wetlands
Herbaceous Wetlands	Generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). Various grasses or grass-like plants dominate or co-dominate these habitats.
Montane Coniferous Wetlands	Forest or woodland dominated by evergreen conifers; deciduous trees may be co-dominant; understory dominated by shrubs, forbs, or graminoids; mid- to upper montane.
Eastside (Interior) Riparian Wetlands	Shrublands, woodlands and forest, less commonly grasslands, often multi-layered canopy with shrubs, graminoids, forbs below.

(IBIS 2003)



(DCTLS 2004)

Figure 30 Historic wildlife habitat types of the UMM Subbasin, WA.



(DCTLS 2004)

Figure 31 Current wildlife habitat types of the UMM Subbasin, WA.

Table 17 Changes in wildlife habitat types in the UMM Subbasin, Washington, from circa 1850 (historic) to 199 (current)

Habitat Types	Historic	Current	Changes (acres)	Changes (%)
Montane Mixed Conifer Forest	Unknown	10,500		
Eastside (Interior) Mixed Conifer Forest	Unknown	24,401		
Lodgepole Pine Forest and Woodlands	Unknown	1,045		
Ponderosa Pine Forest and Woodlands	100,329	50,843	-49,487	-49
Upland Aspen Forest	Unknown	292		
Alpine Grasslands and Shrublands	Unknown	421		
Subalpine Parkland	Unknown	1,179		
Eastside (Interior) Grasslands	117,133	14,396	-102,737	-88
Shrubsteppe	1,237,065	753,073	-483,992	-39
Agriculture, Pastures, and Mixed Environs	0	693,861	693,861	100
Urban and Mixed Environs	0	8,026	8,026	100
Montane Coniferous Wetlands	Unknown	407		
Eastside (Interior) Riparian-Wetlands	Unknown	3,898		
Herbaceous Wetlands	Unknown	3,514		
Open Water - Lakes, Rivers, and Stream	7,166	41,882	34,716	484

(IBIS 2003)

Rationale and Selection of Focal Habitats

A “coarse filter/fine filter” approach was used to select focal habitat (Haufler 2002). The coarse filter compares the current availability of focal species habitat against historic availability to evaluate the relative status of a given habitat and its suite of obligate species. To ensure that “nothing drops through the cracks,” the coarse filter habitat analysis was combined with a single species or “fine filter” analysis of one or more obligate species to further ensure that species viability for the suite of species is maintained. For a more detailed discussion of focal wildlife species selection and rationale, see section 4.1.3 in Ashley and Stovall (unpub. rpt., 2004).

The following four key principles/assumptions were used to guide selection of focal habitats: 1) Focal habitats were identified by WDFW at the CCP level and reviewed/modified at the subbasin level, 2) Focal habitats can be used to evaluate ecosystem health and establish management priorities at the CCP level (course filter), 3) Focal species/guilds can be used to represent focal habitats and to infer and/or measure response to changing habitat conditions at the subbasin level (fine filter), 4) Focal species/guilds were selected at the subbasin level.

To identify focal macro habitat types within the CCP, CCP planners used the assessment tools to develop a habitat selection matrix based on various criteria, including ecological, spatial, and cultural factors. As a result, subbasin planners selected four focal wildlife habitat types out of the seventeen that occur within the CCP (Table 18). Focal habitats selected for the UMM Subbasin include shrubsteppe, riparian wetlands, and herbaceous wetlands. Neither the IBIS nor the

Washington GAP Analysis data recognize the historic presence of herbaceous wetlands or riparian wetlands. Additionally, the current extent of these habitat types as reflected in these databases is suspect at best; however, NWI (FWS 1999-0518), hydric soils data (NRCS) and WDFW Priority Habitat and Species data were used to represent current riparian wetland and herbaceous wetland habitats. The amount of extant acres for each focal habitat type is illustrated by subbasin in Table 18.

Table 18 A comparison of the amount of current focal habitat types for each subbasin in the CCP, WA.

Subbasin	Focal Habitat			
	Ponderosa Pine (acres)	Shrubsteppe (acres)	Riparian Wetlands (acres)	Herbaceous Wetlands (acres)
Entiat	55,807	32,986	94	
Lake Chelan	45,480	45,018	5,079	
Wenatchee	51,912	24,248	141	
Methow	139,853	107,655	4,232	
Okanogan	140,738	562,763	9,920	
UMM	**50,843**	**753,073**	**3,898**	**6,032**
Crab	4,660	991,397	12,227	

(IBIS 2003, FWS 1999-0518)

Focal Habitat Changes

Changes in the extent of focal habitats within the Subbasin are summarized in Table 19. The UMM Subbasin shows a decrease in the extent of shrubsteppe habitat.

IBIS herbaceous wetland and riparian wetland historic habitat data are incomplete and not suitable for use in subbasin level analyses. As a result, riparian and herbaceous wetland analyses are incomplete. Accurate habitat type quantification, especially those detailing riparian and herbaceous wetland habitats, are needed to improve assessment quality and support management strategies. In spite of the lack of quantifiable historic habitat conditions, subbasin wildlife managers believe that significant physical and functional losses have occurred to these wetland habitats.

Table 19 Changes in focal wildlife habitat types in the UMM Subbasin, WA., from circa 1850 (historic) to 1999 (current)

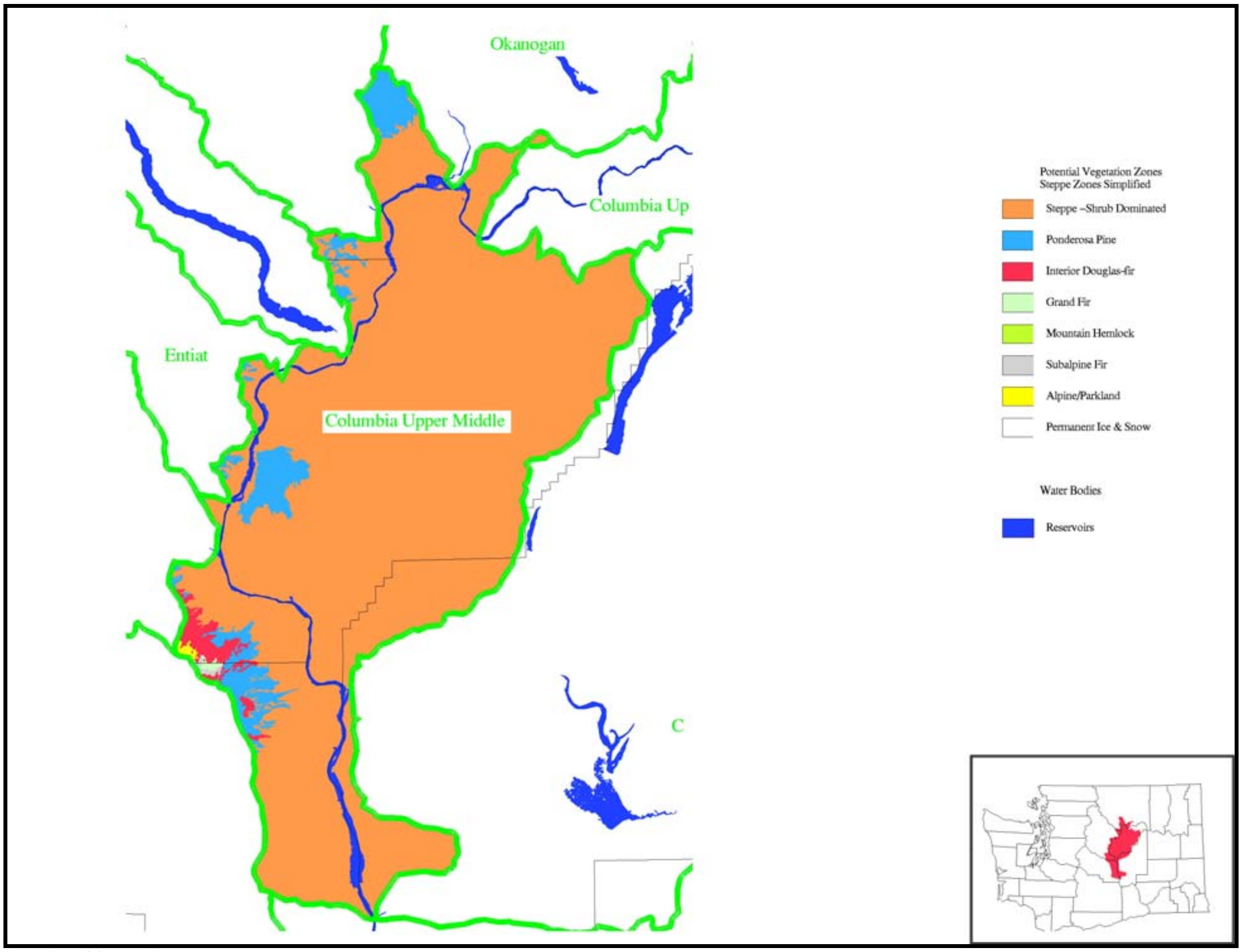
Focal Habitat Type	Historic Acres1	Current Acres	Acre Change	Percent Change
Shrubsteppe	1,237,065	753,073	-483,992	-39
Eastside (Interior) Riparian Wetlands	Unknown	3,898	Unknown	Unknown
Herbaceous Wetlands	Unknown	3,514	Unknown	Unknown
Agriculture	0	693,861	693,861	+100

Focal Habitat Type	Historic Acres1	Current Acres	Acre Change	Percent Change
[1] Historic GAP and IBIS riparian and herbaceous wetland data are not suitable for subbasin level analysis. See Wildlife Habitat Assessment Methods for explanation of data limitations.				

(IBIS 2003)

4.2.3 Shrubsteppe Assessment Unit

The shrubsteppe habitat type is described in section 4.1.7.2 of Ashley and Stovall (unpub. rpt., 2004). Shrubsteppe habitat in the UMM Subbasin is illustrated in Figure 32.



(Cassidy 1997)

Figure 32 Potential shrubsteppe habitat in the UMM Subbasin, WA.

Habitat Structure and Composition

Shrubsteppe was historically co-dominated by shrubs and perennial bunchgrasses with a micro biotic crust of lichens and mosses on the surface of the soil. Shrubsteppe that was located in areas of deep soil have largely been converted to agriculture leaving shrubsteppe intact on shallow lithosols soil. Floristic quality, however, has generally been impacted by decades of heavy grazing, introduced vegetation, wild fires, and other anthropogenic disturbances. In addition, habitat alterations from loss of native wildlife interactions/associations are largely unknown.

The greatest changes in the remaining shrubsteppe habitat from historic conditions are the reduction of bunchgrass cover in the understory and an increase in sagebrush cover. Soil compaction is also a significant factor in heavily grazed lands affecting water percolation, runoff, and soil nutrient content. A long history of grazing, fire, and invasion by exotic vegetation has altered the composition of the plant community within much of the extant shrubsteppe in this region (Knick 1999, Quigley and Arbelbide 1997), and it is difficult to find stands that are still in relatively natural condition.

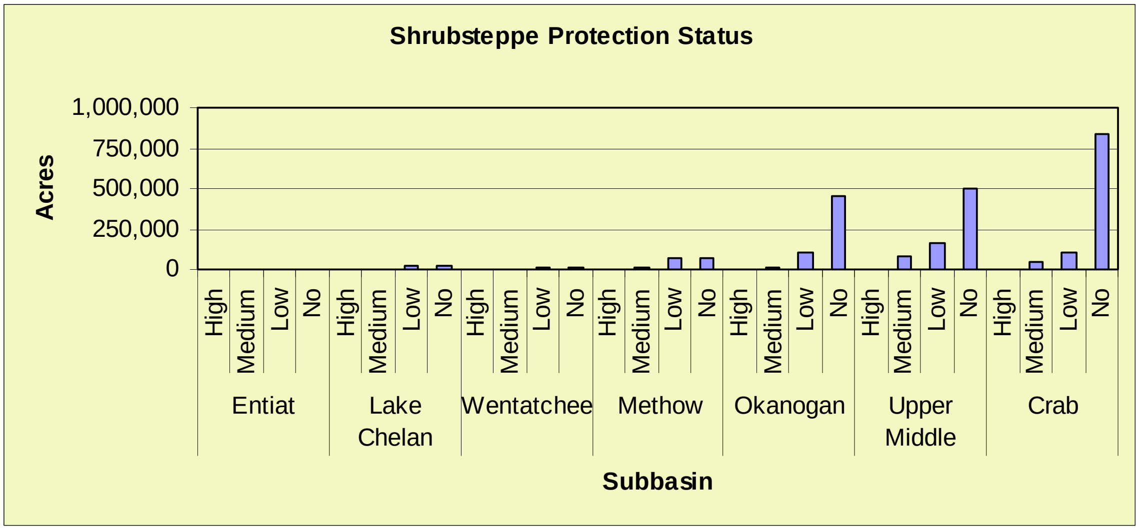
Fire has relatively little effect on native vegetation in the three-tip sagebrush zone, since three-tip sagebrush and the dominant graminoids resprout after burning. Three-tip sagebrush does not appear to be much affected by grazing, but the perennial graminoids decrease and are eventually replaced by cheatgrass (*Bromus tectorum*), thread-leaved sedge (*Carex filifolia*), and/or gray rabbitbrush (*Chrysothamnus nauseosus)*. In recent years, diffuse knapweed (*Centaurea diffusa*) and Dalmation toadflax (*Linaria dalmatica*) have spread through this zone and threaten to replace other exotics as the chief increaser after grazing (Roche and Roche 1998).

In areas of central arid steppe with a history of heavy grazing and fire suppression, true shrublands are common and may even be the predominant cover on non-agricultural land. Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock. Grazing eventually leads to replacement of the bunchgrasses with cheatgrass, small fescue (*Vulpia microstachys*), sixweeks fescue (*V. octofiora),* and Indian wheat (*Plantago patagonica*) (Harris and Chaney 1984). In recent years, several knapweeds (*Centaurea* spp.) have become increasingly widespread. Russian knapweed (*Centauries ripens)* is widespread, along and near major watercourses, streams, ponds, springs, seeps, or any disturbed site with suitable soil moisture (Roche and Roche 1988).

Status, Trends, and Limiting Factors

Protection Status

The protection status of shrubsteppe habitat for CCP subbasins is compared in Figure 33. The protection status of remaining shrubsteppe habitats in all subbasins is primarily within the "low" to "no protection" status categories. As a result, this habitat type will likely suffer further degradation, disturbance, and/or loss in all CCP subbasins. Protection status of shrubsteppe habitat within the UMM Subbasin is illustrated in Figure 33 and Table 20.



(IBIS 2003)

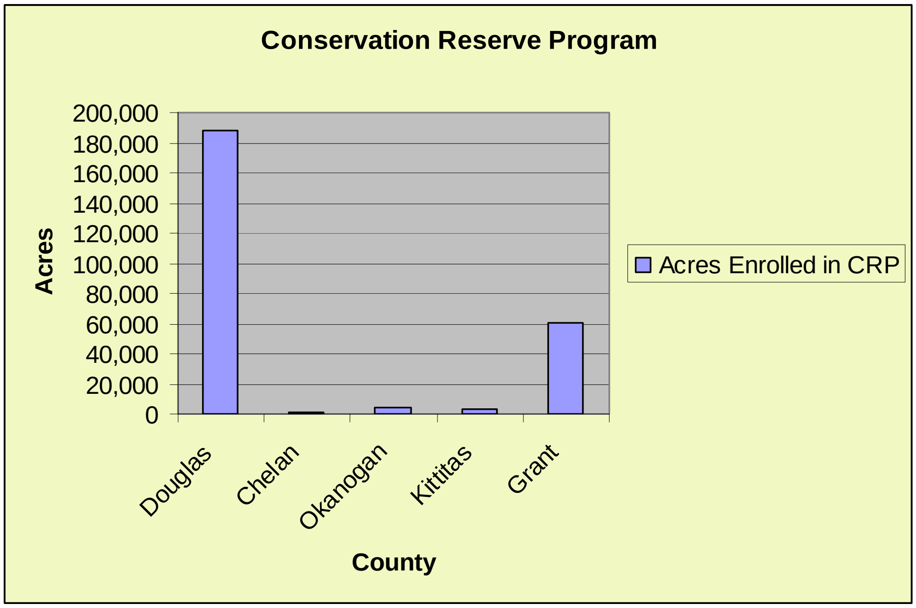
Figure 33 GAP protection status of shrubsteppe habitat in the CCP, Washington

Table 20 Shrubstepp habitat GAP protection status in the UMM Subbasin, WA.

GAP Protection Status	Acres
High Protection	0
Medium Protection	109,523
Low Protection	312,766
No Protection	1,185,451

(IBIS 2003)

Shrubsteppe-like habitat established through implementation of the Conservation Reserve Program receives short-term/high protection. The number of acres protected by CRP are compared by county in Figure 34 and listed in Appendix D.



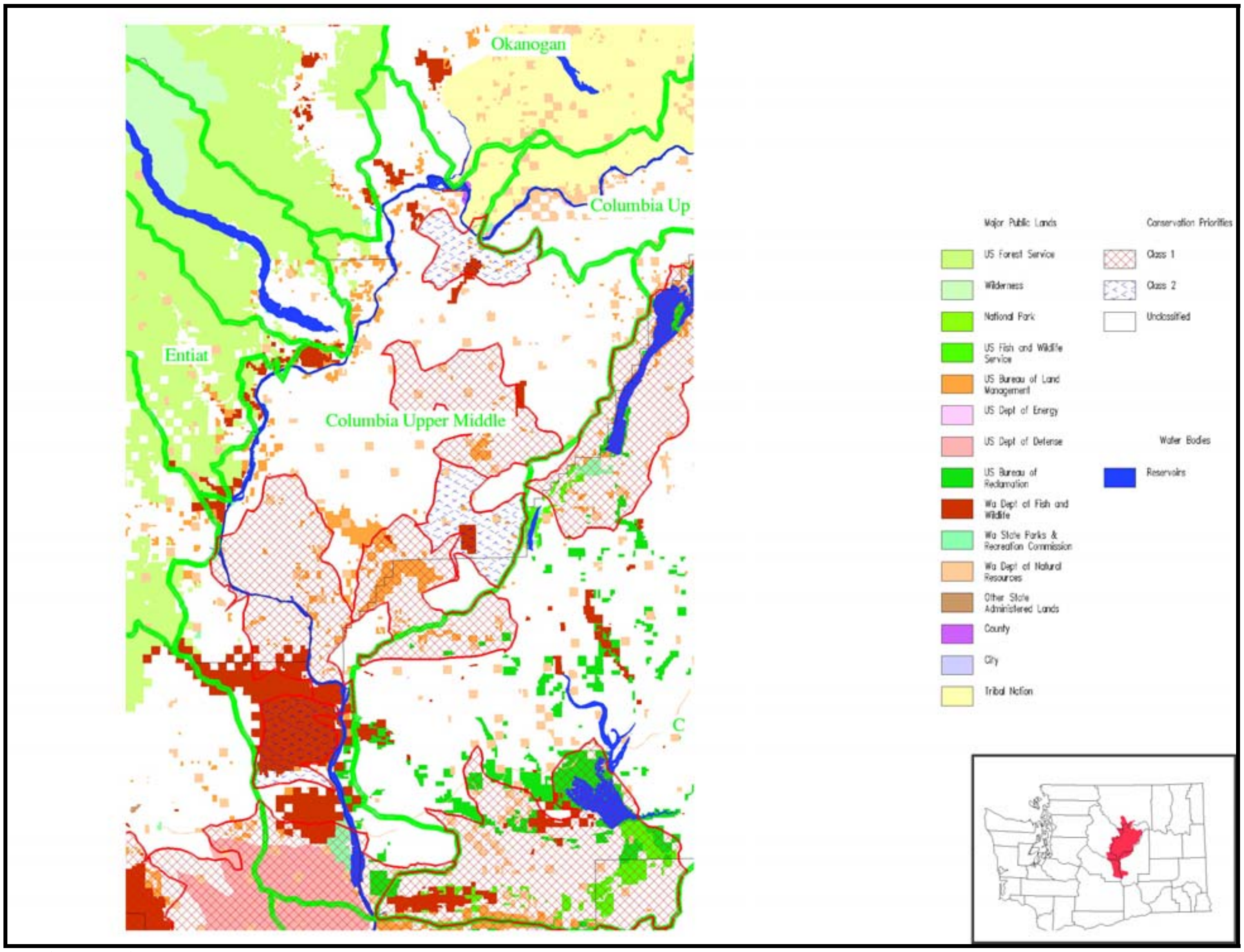
(FSA, unpublished data, 2003).

Figure 34 Acres protected through the CRP

Ecoregion Conservation Assessment Priorities

Subbasin ECA priorities and public land ownership are illustrated in Figure 35. The Ecoregion Conservation Assessment is further discussed in section 4.2 of Ashley and Stovall (unpub. rpt., 2004). An extensive area of shrubsteppe in the central portion of the Subbasin is comprised of ECA class 1 lands. Three areas in the Subbasin, comprised largely of shrubsteppe habitat owned and managed by WDFW, are designated ECA class 2. The majority of these class 2 lands are provided some threat protection primarily through public ownership. Washington Department of Fish and Wildlife ECA planners, with local input, may identify additional shrubsteppe habitats as ECA priority areas when ECA data are updated.

Subbasin planners can use ECA data, in conjunction with other tools such as IBIS and Streamnet, to identify areas in which to focus protection strategies and conservation efforts. Protection of critical habitats on private lands, located adjacent to existing public lands, within ECA designated areas is a high priority within the Subbasin and EcoCCP.



(ECA 2003)

Figure 35 ECA and publicly owned lands in the UMM Subbasin, WA.

Limiting Factors

Factors affecting shrubsteppe habitat are explained in detail in section 4.2.10.2 (Ashley and Stovall (unpub.rpt. 2004) and are summarized below:

- Shrubsteppe/grassland habitats are destroyed (e.g., approximately 60 percent of shrubsteppe in Washington [Dobler et al. 1996]) because of permanent conversions to agriculture and urban uses and remaining tracts of moderate to good quality shrubsteppe habitat are fragmented.
- Habitats are degraded by intensive grazing and invasion of exotic plant species, particularly annual grasses such as cheatgrass, diffuse knapweed, and Dalmatian toadflax.
- Urban and rural residential development/encroachment and conversion to agriculture degrade and destroy properly functioning shrubsteppe ecosystems. The best sites for healthy sagebrush communities have deep soil and relatively mesic conditions, but are also best for agricultural productivity, therefore past losses and potential future losses are great. Most of the remaining shrubsteppe in Washington is in private ownership with little long-term protection (57 percent).

- Big sagebrush communities are lost to brush control; however, this may not be detrimental relative to interior grassland habitats.
- CRP lands may be converted back to cropland or rangeland.
- Cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities, are reduced and destroyed.
- High densities of nest parasites (e.g., brown-headed cowbird) and domestic predators, primarily cats, may be present in hostile/altered landscapes, particularly those in proximity to agricultural and rural development, and residential areas subject to high levels of human disturbance.
- Agricultural and grazing practices cause direct or indirect mortality and/or reduce wildlife productivity.

Recommended Future Conditions

Recommended future conditions are described in section 4.1.7.2.3 in Ashley and Stovall (unpub. rpt., 2004) and are summarized as follows:

Sagebrush-dominated Shrubsteppe:

Condition 1– Deep soil shrubsteppe: Pygmy rabbit was selected to represent species dependent on deep rock-free soil (greater than 20 inches deep) underlying shrubsteppe habitat with patches of dense tall sagebrush (average 32.7 percent shrub cover and shrub height of 32 inches) (Gahr 1993).

Condition 2 – Sagebrush dominated shrubsteppe habitat: The sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat (Knick and Rotenberry 1995; Paige and Ritter 1999; Vander Haegen et al. 2001). Suitable habitat includes 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover.

Steppe/Grassland-dominated Shrubsteppe:

Condition 1 – Sagebrush habitat with diverse native herbaceous understory: Sage grouse were selected to represent species that require/prefer diverse sagebrush habitat with medium to high shrub cover and residual grass. Sage grouse prefer slopes less than 30 percent, sagebrush/bunchgrass stands having medium to high canopy cover (10-30 percent), forb/grass cover at least 15 percent, and less than 10 percent non-native herbaceous cover.

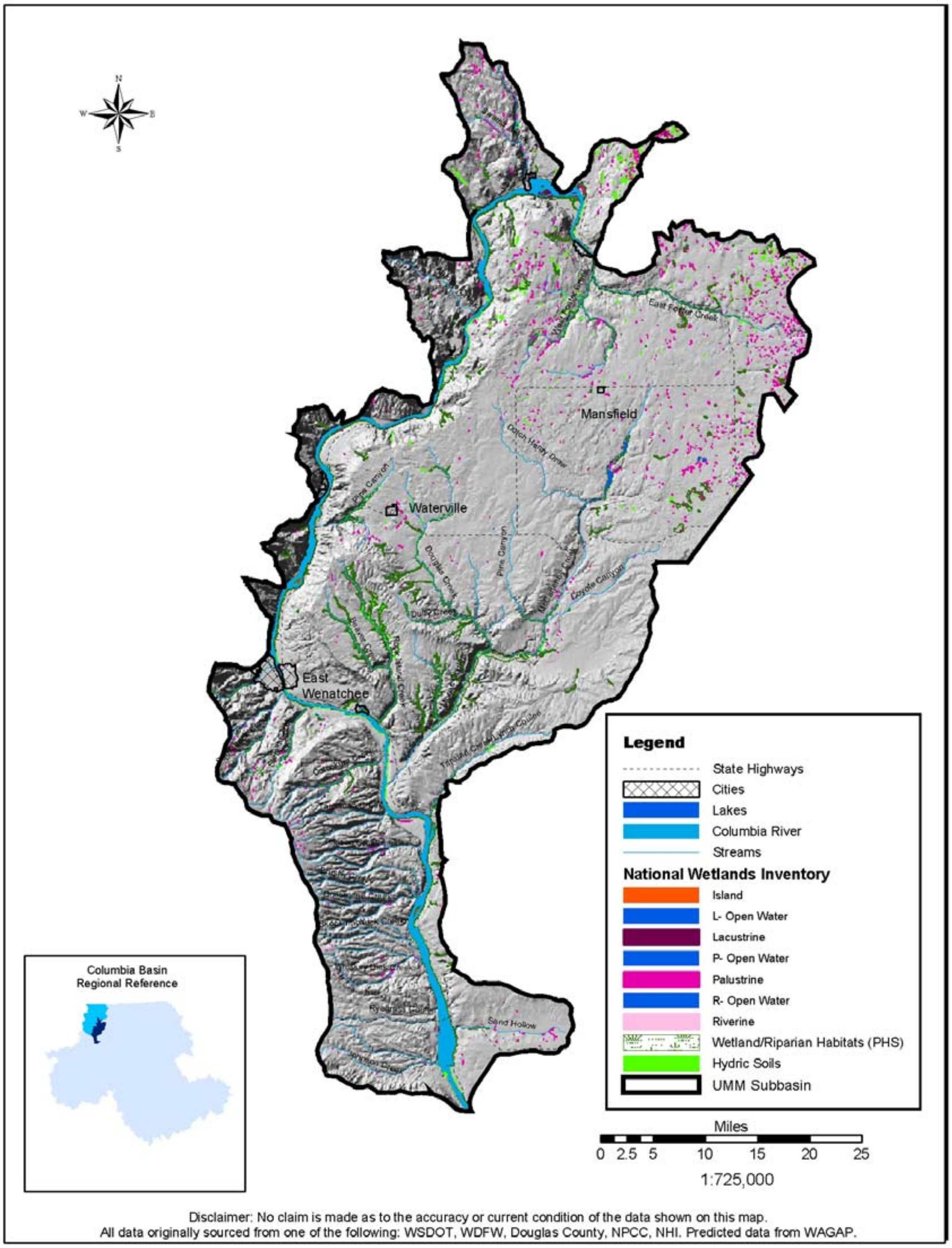
Condition 2 – Shrubsteppe habitat with multi-structured deciduous trees and shrubs: Sharp-tailed grouse were selected to represent species that require multi-structured, fruit/bud/catkin producing deciduous trees and shrubs dispersed throughout the landscape (10 to 40 percent of the total area). Other habitat conditions include:

- Native bunchgrass greater than 40 percent cover
- Native forbs with at least 30 percent cover
- Visual obstruction readings (VOR) of at least 6 inches

- At least 75 percent deciduous shrubs and trees cover
- Exotic vegetation/noxious weeds of less than 5 percent cover

4.2.4 Eastside (Interior) Riparian Wetlands Assessment Unit

The eastside (interior) riparian wetlands habitat type (Figure 36) refers only to riverine and adjacent wetland habitats in both the CCP and individual subbasins. According to the IBIS database (2003), there are an estimated 3,898 acres of riparian wetland habitat currently in the Subbasin, which is an underestimate (see Wildlife Habitat Assessement Methods). GAP analysis estimated 11,544 acres (Cassidy 1997). Subbasin planners relied on a combination of data sources to depict current riparian wetland distribution in the subbasin. Although there are no historic data to make comparisons, the actual number of acres or absolute magnitude of the change is less important than recognizing a loss of riparian habitat has occurred and the lack of permanent protection continues to place this habitat type at further risk.



(DCTLS 2004)

Figure 36 Wetland and riparian habitat in the UMM Subbasin, WA.

Habitat Structure and Composition

Historically, riparian wetland habitat was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly or in some combination by grass-forbs, shrub thickets, and mature forests with tall deciduous trees. Beaver activity and natural flooding are two ecological processes that affected the quality and distribution of riparian wetlands.

Today, agricultural conversion, altered stream channel morphology, and water withdrawal have played significant roles in changing the character of streams and associated riparian areas. Woody vegetation has been extensively suppressed by grazing in some areas, many of which continue to be grazed. At lower elevations, agricultural conversions have led to altered stream channel morphology, loss of riparian vegetation and water withdrawals for irrigation.

In some areas, the amount of riparian habitat has increased because of the stability the upstream storage projects provide in periods of high flows. These flows have created suitable habitat for migrant and wintering waterfowl and other species because of the increased open water associated with the reservoirs (T. Dresser, Grant PUD, pers. comm., 2004).

Embayments also provide diverse riparian vegetative communities and important wildlife habitat because of their reduced water fluctuation and protection from wave action. These shallow water habitats are typically connected to the Columbia River via culverts or small channels. Water fluctuates less in many of these areas than in the river because of the elevation of the culvert or inlet channel, and the magnitude of waves is also relatively low. Embayments are of special importance to beaver and also provide protected resting, roosting, and food resources for water birds. (T. Dresser, Grant PUD, pers. comm., 2004)

Status, Trends and Limiting Factors

Protection Status

The vast majority of CCP riparian habitat is designated low or no protection status and is at risk for further degradation or conversion to other uses. The GAP protection status of riparian wetland habitat in the UMM Subbasin is depicted in Table 21.

Table 21 Eastside (interior) riparian wetlands GAP protection status in the UMM Subbasin, WA.

GAP Protection Status	Acres
High Protection	0
Medium Protection	274
Low Protection	647
No Protection	2,974

(IBIS 2003)

Limiting Factors

Factors affecting Eastside (interior) Riparian Wetland habitat are described in section 4.2.10.3 in Ashley and Stovall (unpub. rpt., 2004) and summarized below:

- Habitat is degraded or lost because of numerous factors including riverine recreational developments, inundation from impoundments, cutting and spraying of riparian vegetation for eased access to water courses, etc.
- Habitat, in the tributaries of the Columbia River, is altered by 1) hydrological diversions and control of natural flooding regimes that result in reduced stream flows and reduction of

overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and 2) stream bank stabilization, which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation.

- Livestock overgrazing widens channels, raises water temperatures, and reduces understory cover.
- Native riparian shrub and herbaceous vegetation is converted to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, Russian knapweed, Canada thistle, and Russian olive.
- Large tracts necessary for area-sensitive species, such as the yellow-billed cuckoo, are fragmented and lost.
- Hostile landscapes, particularly those in proximity to agricultural, rural, and residential developments, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.
- High energetic costs associated with high rates of competitive interactions with European starlings for cavities may reduce reproductive success of cavity-nesting species such as Lewis' woodpecker, downy woodpecker, and tree swallow, even when outcome of the competition is successful for these species.
- Riparian habitats are negatively impacted by recreational disturbances (e.g., ORVs), particularly during nesting season and in high-use recreation areas.
- Habitat is altered down to the edge of streams or rivers by farming.

Recommended Future Conditions

Recommended future conditions are described in detail in section 4.1.7.3.3 in Ashley and Stovall (unpub. rpt., 2004). Recommended conditions for riparian wetland habitat are summarized in the following paragraphs.

Condition 1 – Multi-structured, dense understory: Willow flycatcher was selected to represent species that require dense patches of native vegetation in the shrub layer and interspersed with openings of herbaceous vegetation. Willow flycatchers require 40-80 percent shrub cover, shrubs greater than 3 feet in height, and tree cover less than 30 percent.

Condition 2 – Deciduous riparian zone with high canopy closure: Beaver was selected to represent species that require 40-60 percent tree/shrub canopy closure and shrub height greater than 6.6 feet. Beavers also require trees less than 6 inches DBH.

Condition 3 – Mature deciduous forest with open canopy: Lewis’ woodpecker was selected to represent species that require or depend on mature cottonwood forest for its reproductive life requisites. Lewis’ woodpecker requires trees greater than 21 inches DBH, 10-40 percent canopy cover, and 30-80 percent shrub cover.

4.2.5 Herbaceous Wetland Assessment Unit

According to the IBIS database (2003), there are an estimated 3,514 acres of herbaceous wetland habitat currently in the Subbasin, which is an underestimate (see Wildlife Habitat Assessement Methods) while an analysis of NWI data (FWS 1999-0518) estimated 6,032 acres. Subbasin planners relied on a combination of data sources to depict current herbaceous wetlands distribution in the subbasin. Although there are no historic data to make comparisons, the actual number of acres or absolute magnitude of the change is less important than recognizing a loss of herbaceous wetlands habitat has occurred and the lack of permanent protection continues to place this habitat type at further risk.

Habitat Structure and Composition

Physical

Herbaceous wetlands include depressional wetlands of two basic types: lacustrine and palustrine (i.e., around lakes/ponds and swampy areas). This habitat is found on permanently flooded sites that are usually associated with oxbow lakes, dune lakes, or potholes. Seasonally to semi-permanently flooded wetlands are found where standing freshwater is present through part of the growing season and the soils stay saturated throughout the season. In the Columbia Basin, many of the herbaceous wetlands lie in topographic depressions that are not within the active channel of a stream or river. Wetlands in an active channel or that are frequently flooded (at least once every two years) are classified as “Riverine”. Depressional wetlands are located in the channeled scablands, wind blown loess and sand dunes, glacial kettles or potholes, and alluvial and basalt terraces, particularly along the Columbia River (Hruby and Stanley 2000).

Herbaceous wetlands are also classified as either alkali or freshwater wetlands. Alkali wetlands are not as common on the landscape as freshwater wetlands in the Columbia Basin, but they do provide some unique habitat features. The ecological processes in these wetlands are dominated by the high salt concentrations in the water. The most visible result of the salt is a unique set of plants that have adapted to these conditions. Only a few species have adapted to these conditions and the species richness in alkali systems is much lower than in freshwater systems. Although richness may be low, abundance can be very high for those species that have adapted (especially among some invertebrates) (Hruby and Stanley 2000).

Depressional freshwater wetlands are defined as those whose conductivity is consistently below 2000 µSiemens/cm. The water regime in non-alkali wetlands tends to be dominated by surface runoff or groundwater in areas where inflow exceeds water losses through evaporation or evapotranspiration.

Herbaceous wetland habitat is maintained through a variety of hydrologic regimes that limit or exclude invasion by large woody plants. Habitats are permanently flooded, semi-permanently flooded, or flooded seasonally and may remain saturated through most of the growing season. Most wetlands are resistant to fire and those that are dry enough to burn usually burn in the fall. Most plants are sprouting species and recover quickly. Beavers play an important role in creating ponds and other impoundments in this habitat. Trampling and grazing by large native mammals is a natural process that creates habitat patches and influences tree invasion and success (IBIS 2003).

During years with adequate precipitation, wetlands in Grant, Douglas, Okanogan, and Lincoln counties support the most productive and diverse waterfowl breeding communities in the Pacific Northwest. Grasslands and shrubsteppe habitats surrounding these wetlands provide habitat for upland nesting ducks. The Columbia Basin Irrigation Project has created numerous wetlands that are more persistent but less productive for breeding waterfowl as a result of wetland succession and invasion by exotic, undesirable vegetation. The crops that are grown in this Subbasin, in concert with large reservoirs, wetlands, canals, and wasteways provide ideal conditions for many species of migrating and wintering waterfowl (Quinn 2001).

Vegetative

The herbaceous wetland habitat is generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). Various grasses or grass-like plants dominate or co-dominate these habitats. Cattails (*Typha latifolia*) occur widely, sometimes adjacent to open water with aquatic bed plants. Several bulrush species (*Scirpus acutus, S. tabernaemontani, S. maritimus, S. americanus*, *S. nevadensis*) occur in nearly pure stands or in mosaics with cattails or sedges (*Carex* spp.). These meadows often occur with deep or shallow water habitats with floating or rooting aquatic forbs. Herbaceous cover is open to dense. The habitat can be comprised of tule marshes >6.6 ft (2 m) tall or sedge meadows and wetlands <3.3 ft (1 m) tall. Shrubs or trees are not a common part of this herbaceous habitat although willow (*Salix* spp.) or other woody plants occasionally occur along margins. Important introduced grasses that increase and can dominate with disturbance in this wetland habitat include reed canary grass (*Phalaris arundinacea*), tall fescue (*Festuca arundinacea)* and Kentucky bluegrass (*Poa pratensis*) (IBIS 2003).

Many plants found in alkali systems are unique such as *Distichlis spicata, Scirpus maritimus* or *Scirpus americanu*s. These plants tend to be sparse and relatively short (<1m). As a result, alkali systems often have extensive mudflats and meadows of short grass that attract certain species of waterfowl and shorebirds. Alkali wetlands provide critical habitat for many species of migratory birds (Hruby and Stanley 2000).

Fresh water wetlands with water present greater than nine months typically have a ring of bulrush *(Scirpus spp.*) or cattails *(Typha spp.*) around an area of open water (or mudflats in very dry years). White water buttercup *(Ranunculus aquatili*s), burreed *(Sparganium emersum*), American water-plaintain *(Alisma plantago-aquatica*), or American water-plaintain *(Alisma plantago-aquatic*a) can also be present (Hruby and Stanley 2000).

Herbaceous wetlands are often in a mosaic with shrub- or tree-dominated wetland habitat. Woody species can successfully invade emergent wetlands when this herbaceous habitat dries. Emergent wetland plants invade open-water habitat as soil substrate is exposed; e.g., aquatic sedge and Northwest Territory sedge (*Carex utriculata*) are pioneers following beaver dam breaks. As habitats flood, woody species decrease to patches on higher substrate (soil, organic matter, large woody debris) and emergent plants increase unless the flooding is permanent. Fire suppression can lead to woody species invasion in drier herbaceous wetland habitats (IBIS 2003).

Status, Trends, Limiting Factors

Nationally, herbaceous wetlands have declined and the Pacific Northwest is no exception. These wetlands receive regulatory protection at the national, state, and county level; still, herbaceous wetlands have been filled, drained, grazed, and farmed extensively. A keystone species, the beaver, has been trapped to near extirpation in parts of the Pacific Northwest and its population has been regulated in others. Herbaceous wetlands have decreased along with the diminished influence of beavers on the landscape. Quigley and Arbelbide (1997) concluded that herbaceous wetlands are susceptible to exotic, noxious plant invasions.

Direct alteration of hydrology (e.g., channeling, draining, damming) or indirect alteration (e.g., roading or removing vegetation on adjacent slopes) results in changes in amount and pattern of herbaceous wetland habitat. If the alteration is long term, wetland systems may reestablish to reflect new hydrology (e.g., cattail is an aggressive invader in roadside ditches). Severe livestock grazing and trampling decreases aquatic sedge, Northwest Territory sedge (*Carex utriculata*), bluejoint reedgrass, and tufted hairgrass. Native species, however, such as Nebraska sedge, Baltic and jointed rush (*Juncus nodosus*), marsh cinquefoil (*Comarum palustris*), and introduced species dandelion (*Taraxacum officinale*), Kentucky bluegrass, spreading bentgrass (*Agrostis stolonifera*), and fowl bluegrass (*Poa palustris*) generally increase with grazing.

Limiting Factors

- Livestock overgrazing reduces emergent and upland vegetation.
- Upland nesting bird habitat (red-winged blackbird and gadwall) is altered and destroyed by mowing, burning, and tillage.
- Native wetland and upland vegetation is replaced with invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, Russian knapweed, Canada thistle, and Russian olive.
- Hostile landscapes, particularly those in proximity to agricultural, rural, and residential developments, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.
- Wetland habitat is disturbed by recreational activities, particularly during nesting season and in high-use recreation areas.
- Exotic wildlife species (e.g., carp) disturb submergent vegetation, destroy habitat for emergent aquatic insects, and affect the productivity of the wetland.
- Habitat within, or adjacent to, herbaceous wetlands is altered by farming.

Protection Status

The vast majority of CCP herbaceous wetland habitat is designated low or no protection status and is at risk for further degradation and/or conversion to other uses. The GAP protection status of herbaceous wetland habitat in the UMM Subbasin is depicted in **Table 22**.

Table 22 Herbaceous wetlands GAP protection status/acres in the UMM Subbasin, WA.

GAP Protection Status	Acres
High Protection	0
Medium Protection	17
Low Protection	118
No Protection	272

(IBIS 2003)

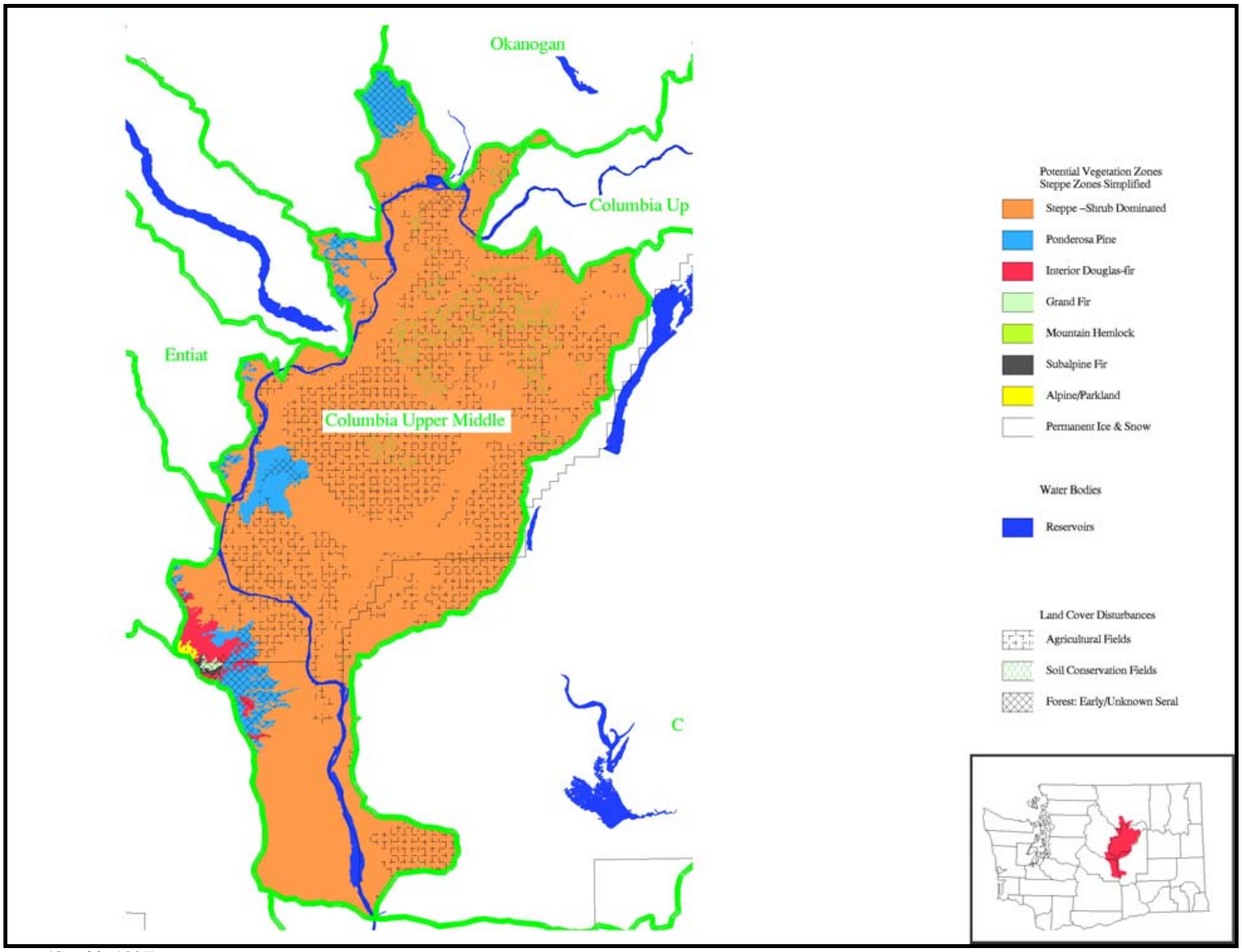
Recommended Future Condition

Recommended conditions for herbaceous wetland habitat are summarized as follows: Condition 1 – Red-winged blackbird was selected to represent the range of habitat conditions of a functional herbaceous wetland and uplands habitat complex to include: Permanent water present at a depth > 20", Emergent vegetation ≥ 0.25 acre with an optimum of open water to emergent vegetation ratio of 40:60, Larvae of damselflies and dragonflies (order Odonota) present, Surrounding uplands (≤ 200 yds.) should include sturdy, dense, robust herbaceous vegetation not disturbed by grazing, mowing, burning, haying etc.

4.2.6 Agriculture (Habitat of Concern)

Agricultural habitat varies substantially in composition with several cover types. Agricultural extent in the Upper Middle Mainstem subbasin is illustrated in Figure 37. Cultivated cropland is primarily devoted to production of dryland winter wheat. Irrigated agriculture is concentrated along the Columbia River, small tributaries in Chelan County south of Wenatchee, and lower Moses Coulee in Douglas County. Crop production in these areas consists primarily of tree fruit and to a lesser degree forage crops (e.g., alfalfa and grass hay).

Because agriculture is not a focal wildlife habitat type and there is little opportunity to effect change in agricultural land use at the landscape scale, CCP and subbasin planners did not conduct a full-scale analysis of agricultural conditions. However, agricultural lands enrolled in the Conservation Reserve Program can provide benefits to shrubsteppe dependent wildlife.



(Cassidy 1997)

Figure 37 Agricultural extent in the UMM Subbasin, WA.

Conservation Reserve Program (CRP)

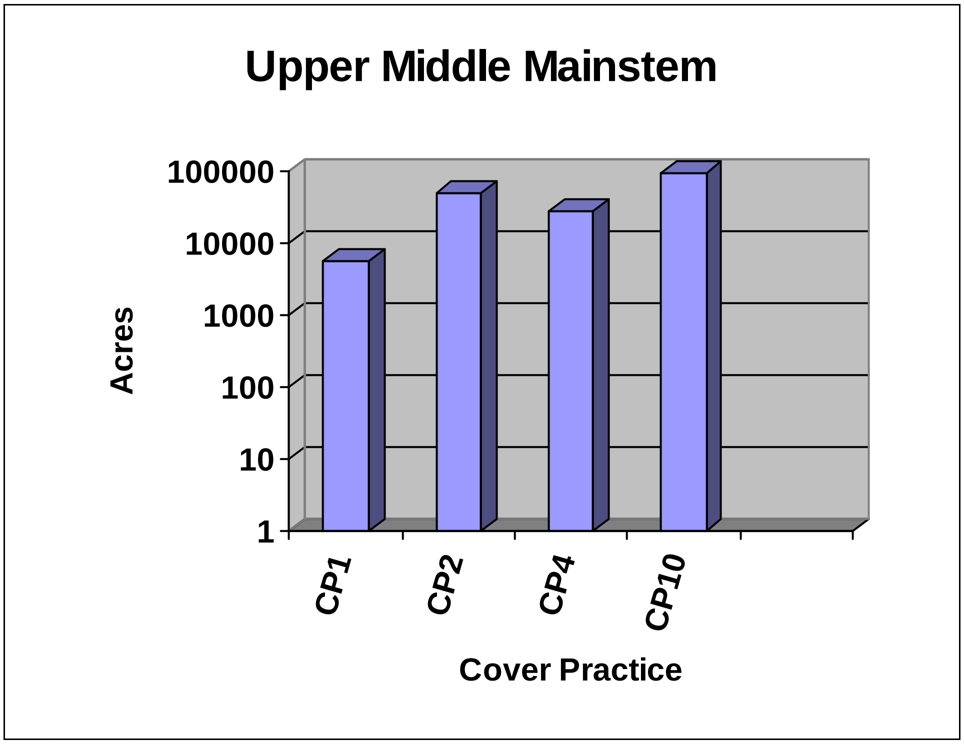
The Conservation Reserve Program (CRP) encourages farmers to convert highly erodible cropland, or other environmentally sensitive acreage, to vegetative cover (native grasses, wildlife plantings, trees, filter strips, or riparian buffer) to establish wildlife habitat, improve water quality by reducing soil erosion and sedimentation, and enhance shrubsteppe and wetland resources. Farmers receive an annual rental payment for the term of the contract, which shall not exceed 10 years per sign-up period. Contract approval is based, in part, on the types of vegetation landowners are willing to plant and cost sharing is provided to establish the vegetative cover practices.

Cover Practice planting combinations are assigned points based on the potential value to wildlife. Cover types that prescribe a mix of native species and are more beneficial to wildlife generally receive the highest scores (FSA, unpub. data, 2003). Cover Practices are summarized and compared in Table 23. Cover Practice seeding requirements change for each signup period. Most of the CRP acreage within the Subbasin (Douglas County) was enrolled in 1997 and 1998. Cover practice participation in the UMM Subbasin is illustrated in Figure 38.

Table 23 Cover Practice descriptions

Cover Practice (CP)	Description
CP1 - Permanent Introduced Grasses and Legumes	Planting of 2 to 3 species of an introduced grass species, or mixture (minimum of 4 species) of at least 3 introduced grasses and at least 1 forbs or legume species best suited for wildlife in the area.
CP2 - Establishment of permanent native grasses	Mixed stand (minimum of 3 species) of at least 2 native grass species and at least 1 forbs or legume species beneficial to wildlife, or mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forbs, or legume species best suited for wildlife in the area.
CP3 -Tree planting (general)	Northern conifers (softwoods) - Conifers/softwoods planted at a rate of 750 to 850 trees per acre depending upon the site index with 10 to 20 percent openings managed to a CP4D wildlife cover, or western pines (softwoods) planted at a rate of 550 to 650 per acre depending upon the site index with 10 to 20 percent openings managed to a CP4D wildlife cover.
CP4B - Permanent wildlife habitat (corridors), non-easement	Mixed stand (minimum of 4 species) of grasses, trees, shrubs, forbs, or legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the participant (more points awarded for a minimum of 5 species). Only native grasses are authorized.
CP4D - Permanent wildlife habitat	Mixed stand (minimum of 4 species) of either grasses, trees, shrubs, forbs, or legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the participant (additional points awarded for a minimum of 5 species). Only native grasses are authorized.
CP-10 - Vegetative cover: grass – already established	A solid stand of 1 to 3 species of introduced grasses, a solid stand of 1 to 3 species of native grasses, or mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forbs, or legume species best suited to Wildlife in the area (native vegetation maximizes points).
CP11 – Vegetative cover: trees – already established	Solid stand of pine/softwood or solid stand of non-mast producing hardwood species, solid stand of a single hard mast producing species, or mixed stand (2 or more species) of hardwoods best suited for wildlife in the area. Pine/softwood established at, or thinned to provide 15 to 20 percent openings of native herbaceous cover and/or shrub plantings/ natural regeneration best suited for wildlife in the area is awarded additional points.
CP 15 – Contour grass strips	Contour grass strips to reduce erosion and control runoff.

(FSA, unpublished data, 2003)



(FSA 2003)

Figure 38 Cover Practice participation in the UMM Subbasin, WA.

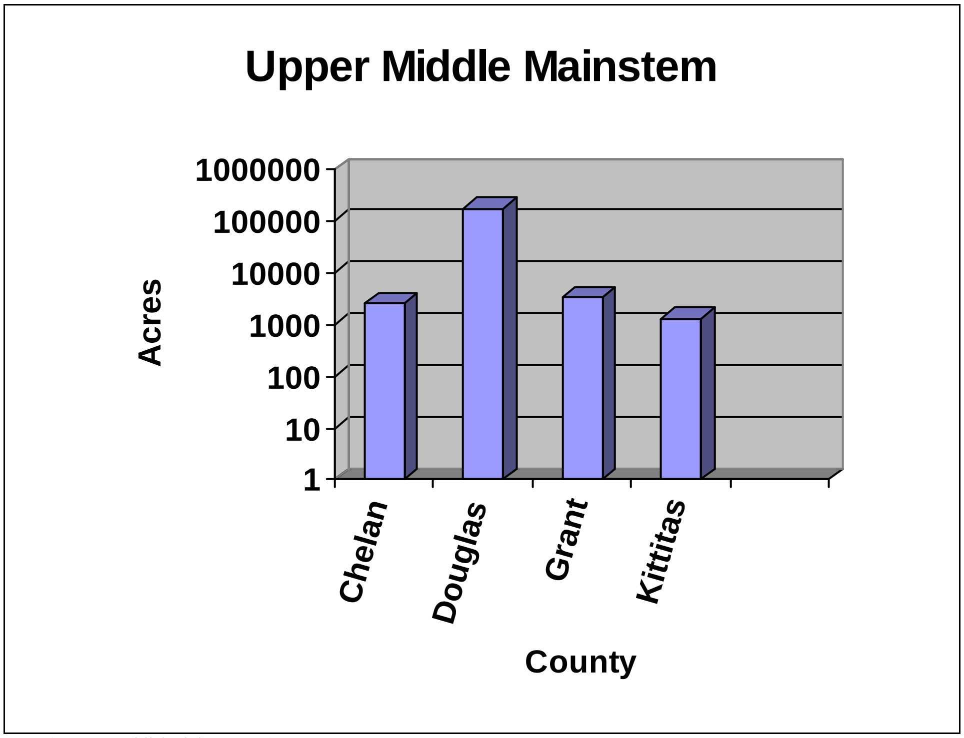
In general, CRP Cover Practices that emphasize wildlife habitat increase the extent of shrubsteppe-like habitats, provide connectivity/corridors between extant native shrubsteppe and other habitat types, reduce habitat fragmentation, increase landscape habitat diversity, reduce soil erosion and stream sedimentation, and provide habitat for a myriad of wildlife species.

Specific wildlife benefits have been documented for sage grouse and sharp-tailed grouse, especially in fields that used multi-species native seed mixes (M. Schroeder, pers. comm., 2004). Additional studies of beneficial aspects of CRP to shrubsteppe dependent birds, mammals and reptiles are currently being conducted by WDFW.

Status, Trends, and Limiting Factors

In the UMM 177,910 acres of cropland are enrolled in CRP. The majority of CRP acreage in the Subbasin occurs in Douglas County (Figure 39). Participation in CRP is limited, by rule, to 25 percent of the eligible cropland in a county. There were provisions included in the program to allow counties to raise the limitation to 33 percent of the total eligible cropland. Douglas County currently falls under this provision. These “waivers” were allowed if there were substantial amounts of highly erodible lands (HEL) or other significant environmental concerns. Present CRP rules no longer allow for waivers based on these criteria. Douglas County currently has approximately 187,000 acres enrolled in CRP in two sign-up periods ending in 2007 and 2008. Due to the loss of the waiver, the total amount of enrolled acres will be reduced by approximately 48,000 acres. This acreage loss will occur when the first re-enrollment period in 2007 begins and represents a direct loss of shrubsteppe-like habitat. Landowners indicate that this land will need to be returned to production to generate needed income (Dudek, pers. comm., 2004). Efforts are underway to work with the NRCS and FSA to avoid this loss or develop a

CRP-like program, independent of USDA, which will keep these CRP fields in perennial cover that is beneficial to wildlife (Hemmer, pers. comm., 2004). The number of acres protected by CRP is compared among the portions of counties included within the Subbasin in Figure 39 and listed statewide by county in Appendix D.



(FSA, unpublished data, 2003)

Figure 39 CRP acres (by county) in the UMM Subbasin, WA.

Protection Status

The vast majority of UMM Subbasin agricultural habitat is designated as low or no protection status and is at risk for further degradation and/or conversion to other uses. Shrubsteppe-like habitat established through implementation of CRP also receives short-term high protection. The GAP protection status of agricultural habitat in the UMM Subbasin is illustrated in Table 24.

Table 24 Agriculture GAP protection status/acres in the UMM Subbasin, WA.

GAP Protection Status	Acres
High Protection	0
Medium Protection	7,415
Low Protection	98,313
No Protection	588,137

(IBIS 2003)

4.2.7 Aquatic/Fish Habitat Conditions

Hatcheries and, or, rearing ponds are located in all of the CCP subbasins , except Lake Chelan, to address natural production of salmon and steelhead and to mitigate for fish lost because of hydroelectric and irrigation development throughout the Columbia River Basin.

4.2.8 Fish Listings

Spring Chinook within the ESU

The Upper Columbia River Spring Chinook (*Oncorhynchus tshawytscha*) were listed as an endangered species on March 24, 1999. The listed Evolutionary Significant Unit (ESU) includes all naturally spawned populations of spring Chinook in accessible reaches of Columbia River tributaries between Rock Island and Chief Joseph dams, excluding the Okanogan River. A few hatchery populations from the Methow and Wenatchee rivers were included in the listed ESU. Critical habitat for the listed ESU was designated on February 16, 2000 and included all river reaches accessible to listed spring Chinook in Columbia River tributaries between Rock Island and Chief Joseph dams, excluding the Okanogan River (Golder Associates 2001). The Assessment Reach of Wanapum Dam to Rock Island Dam was never included as critical habitat for spring Chinook. Both Chinook and steelhead critical habitat were removed temporarily on April 30, 2002 by US District Court.

Adult spring Chinook salmon in the Upper Columbia Basin are not currently known to use the Okanogan River. The temperature regime at the time spring Chinook salmon spawn in the Okanogan River is too high for successful spawning and rearing. Water temperatures are elevated because of natural causes exacerbated by land use practices. In their Endangered Status of One Chinook Salmon ESU Final Rule (U.S. Federal Register 1999), the National Marine Fisheries Service excluded the Okanogan River from their Endangered species listing for the Upper Columbia ESU of spring Chinook salmon. The Okanogan River was excluded because they are extirpated from the basin.

Steelhead within the ESU

Upper Columbia River Steelhead (*Oncorhynchus Mykiss*) were listed as an endangered species on August 18, 1997. The ESU includes all naturally-spawned populations of steelhead in tributaries of the Columbia River upstream from the Yakima River, including the Wenatchee, Entiat, Methow, and Okanogan rivers. The Wells Hatchery steelhead stock were included in the listed ESU because they are considered essential for the recovery of the natural population. Critical habitat for the ESU was designated on February 16, 2000 and included all river reaches accessible to listed steelhead (and associated riparian zones) in Columbia River tributaries between the Yakima River and Chief Joseph Dam (Golder Associates 2001). Steelhead critical habitat was removed temporarily on April 30, 2002 by the US District Court.

Bull Trout

The ‘distinct population segment’ (DPS) for bull trout, incorporating the entire Columbia (i.e., upper and lower), was listed as threatened on June 10, 1998. River reaches within the Columbia have been proposedas critical habitat for bull trout and were selected based on the following factors: connectivity, range wide recovery, genetic diversity, maintenance of multiple life history strategies, and representation of major portions of the species’ historical range. Proposesd bull trout critical habitat is areas currently or historically used by bull trout for foraging, overwintering, and migration and having the potential to support increasing use. These areas must also possess quality habitat containing several primary constituent elements for bull trout (FWS 2002a, 2004).

The Columbia River within the proposed critical habitat reach is adjacent to several bull trout recovery units that extend to the Columbia River. These include the Willamette River, Lower Columbia River, Hood River, Deschutes River, John Day River, Umatilla/Walla Walla River, Middle Columbia River and Upper Columbia River recovery units. Bull trout occur in greatest numbers in the upper Columbia River section of the proposed critical habitat reach where suitable conditions for migration exist in the lower reaches of tributaries. Major tributary systems within the UMM known to support bull trout populations include the Wenatchee, Entiat, and Methow rivers (FWS 2002a, 2004).

Presently, bull trout recovery units for the Columbia River DPS do not include the Columbia River. Although the Columbia has important core habitat elements (foraging, over-wintering, migration, maintaining multiple life history strategies, and providing a corridor to restore connectivity) (Rieman and McIntyre 1993), and bull trout have used or are presently using the Columbia River, sufficient information on the role that the Columbia River should play in bull trout recovery is lacking. To better define the role that the Columbia River will play in the recovery of bull trout, studies to verify their abundance, spatial distribution, and temporal use in the Columbia River are needed (FWS 2002a, 2004).

The FWS has developed a Draft Bull Trout Recovery Plan associated with prosed critical habitat. The critical habitat protion of the plan will be finalized by Septmenber 23, 2004. The Draft Recovery plan encompasses the following objectives: 1) Maintain current distribution of bull trout within core areas in all recovery units and restore distribution where recommended; 2) Maintain or increase bull trout abundance in all recovery units; 3) Restore and maintain suitable habitat conditions for all life history stages and strategies; 4) Conserve genetic diversity and provide opportunity for genetic exchange. Greater use of the Columbia River would be expected through implementation of bull trout recovery plans as habitat conditions improve and populations increase (FWS 2002a, 2004).

4.2.9 Columbia River Assessment Unit

The Columbia River Assessment unit extends from Wanapum Dam at river mile 415.8 to Chief Joseph Dam at river mile 545.1.

Riparian Condition

Undisturbed riparian systems are rare along the UMM. Riparian habitat diversity has declined and is undeveloped in some areas, whereas other areas have increased. Low-bank riparian habitat is extremely rare along the river and some areas that were once dominated by cottonwood have been lost. Some of this habitat was lost because of the development of hydropower on the river that altered the natural flood regime. However, in many areas of the UMM, extremely high flow events prior to installation of the dams scoured what little vegetation there was (Tom Dresser, pers. comm., 2004; Chuck Peven, pers. comm., 2004). Other factors, including agricultural conversion and water withdrawals have also impacted riparian systems in the UMM Subbasin.

As a result, some of the upper middle Columbia now exhibits steep shorelines and sparse riparian vegetation that provide limited fish and wildlife habitat.

Embayments connected to the Columbia River Columbia via culverts or small channels provide special wildlife values. The reduced water fluctuation and protection from wave action is beneficial to wildlife, directly and indirectly, and as a result those conditions promote diverse riparian and wetland vegetative communities.

Fine Sediment

Smoothing of the hydrograph and lack of significant reservoir fluctuation from Columbia Basin hydroelectric development has increased the amount of fine sediment present in Columbia River cobble substrate, especially in the lower portions of reservoirs (Falter et al. 1991). Columbia River anadromous salmonid spawning is concentrated at the upstream portions of reservoirs, where it is generally assumed river hydraulics are sufficient to maintain well-sorted substrates that are relatively free of fine sediment. Water velocity in the upstream reservoir areas is also sufficient for adult anadromous salmonids to move cobble substrate for redd construction.

Water Quantity and Quality

Columbia River flows average more than 180,000 cfs in the UMM. Most of this flow comes from upriver areas in the Columbia River Basin. Upriver contributions from the Columbia Basin in Canada provide 99,200 cfs of average flow in the Columbia River, and much of the balance comes from the Kettle and Spokane rivers. Average flow contributions from the three largest tributaries in the UMM (the Okanogan, Methow and Wenatchee rivers) provide another 7,860 cfs to the Columbia River Columbia River. Hydroelectric operations at Grand Coulee Dam greatly influence river flows for downstream hydroelectric operations.

Maximum pool fluctuations in mid-Columbia reservoirs are generally less than 10 feet. They usually occur during winter when Chinook embryos and alevins are incubating in the substrate. Such fluctuations in water levels in the mid-Columbia region could have an adverse effect on embryos depending upon the degree and duration of the fluctuation and the stage of embryo development. The critical hatching stage of pre-emergent fry susceptible to dewatering occurs annually from late November through late April (Chapman et al. 1982).

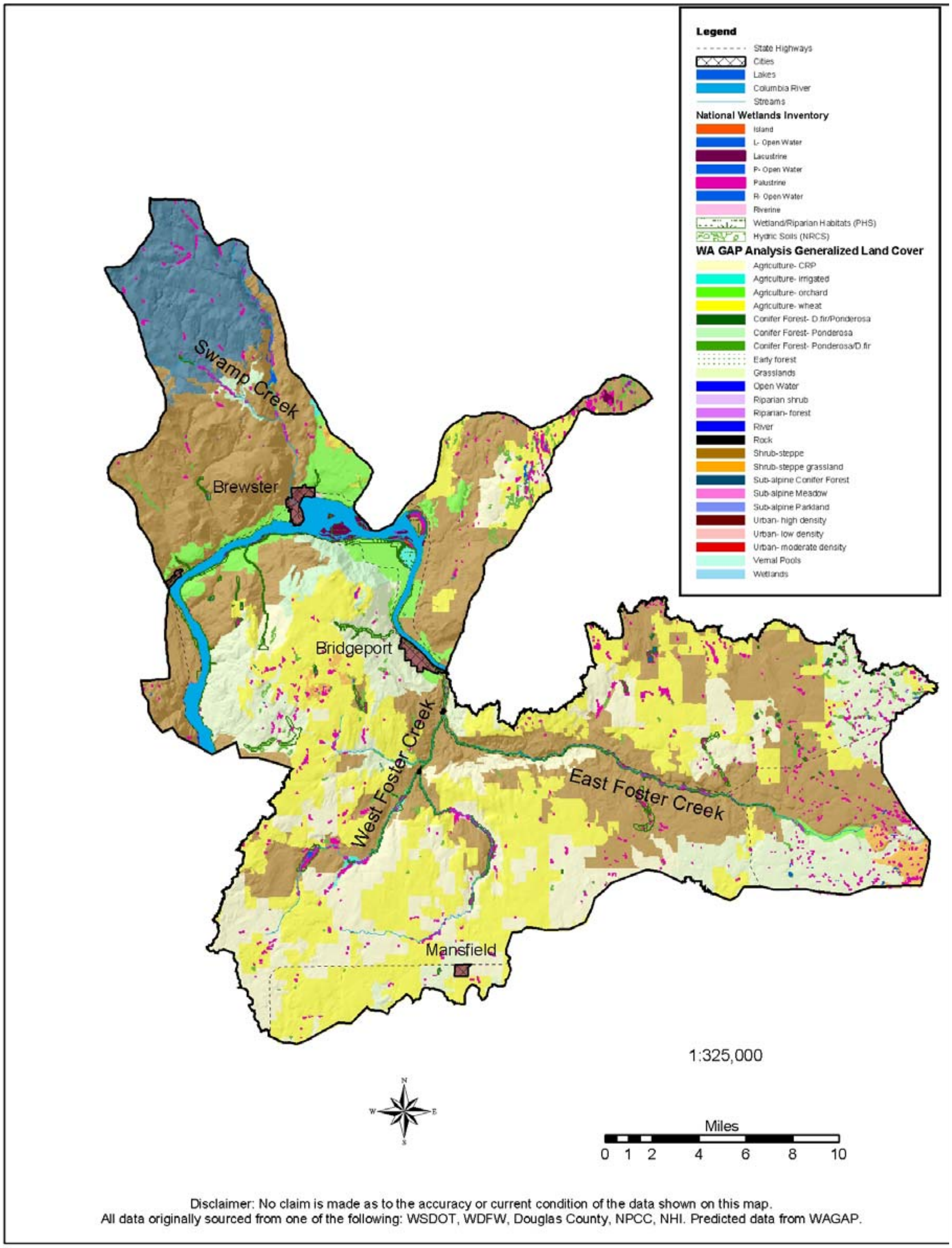
The Columbia River has been classified by the Washington Department of Ecology (WDOE) as a "Class A" water. On a scale ranging from Class AA (extraordinary) to Class C (fair), Class A waters are rated as excellent. State and federal regulations require that Class A waters meet or exceed certain requirements for all uses.

While water quality in the UMM is good compared to other rivers in the United States, there is still cause for concern. Primary concerns include levels of dissolved gases, changes in stream temperatures, turbidity levels and exposure to environmental contaminates above biological thresholds for fish species utilizing the river. These concerns are generally related to hydropower production. The hydroelectric projects on the Columbia River of the Columbia River within the UMM are run-of-river with reservoirs that have little storage capacity. Water velocities are generally fast enough to prevent the formation of a thermocline and the associated depletion of oxygen in deeper waters. Water quality parameters affected by hydropower production, include total dissolved gas (TDG), water temperature, dissolved oxygen, turbidity, suspended sediments and nutrients. The status of each of these parameters in the UMM is summarized in the Appendix E.

4.2.10 Small Tributaries Assessment Unit

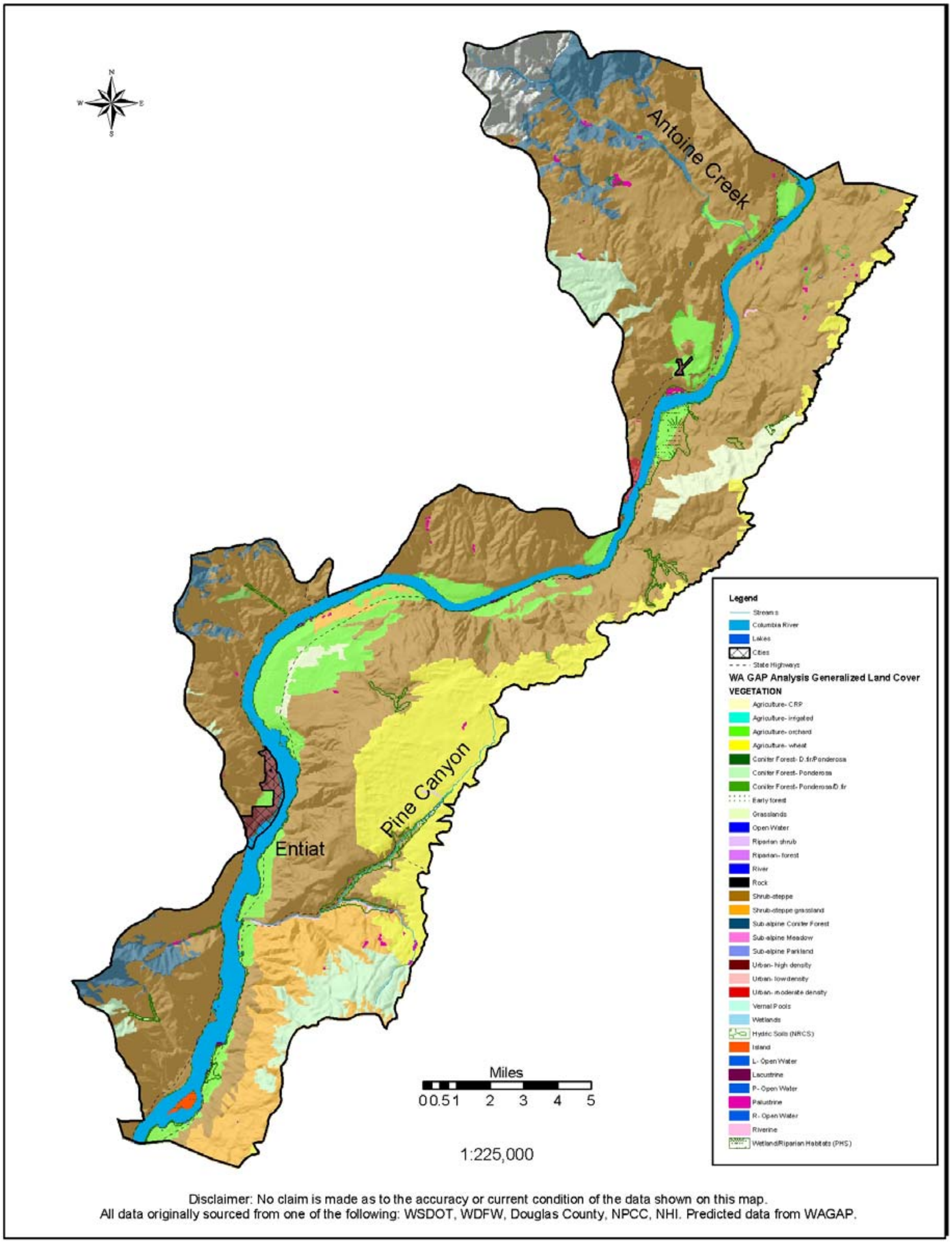
Some generalized statements can be made that apply to all or most of the UMM Subbasin tributaries. Historically, only the very lowest reaches of most of the tributaries would ever have been accessible to Chinook salmon. Most tributaries very quickly become a boulder/cobble-dominated streambed with high gradient runs impassable to spring Chinook. Many of these lower reaches have been inundated by the Columbia River and the habitat dramatically changed as a result of the construction of the Columbia River hydroelectric dams. Rainbow and steelhead would have been distributed throughout the watersheds where habitat was accessible. Maps depicting the location of UMM Subbasin tributaries are shown below (Figure 40 - Figure 43).

In most cases, the extent to which the tributaries can support salmon and steelhead/rainbow trout is most strongly limited by the natural hydrology and geology in this low precipitation region. A large portion of the total annual water production occurs as snowmelt stream flow in April through July. There is an annual excess of available surface water during melt seasons (USFS 1998), but inadequate supplies during the remaining portion of the year. Because of the reliance on snow accumulation and snowmelt to support instream flows in the watershed and the high permeability of the soils, access to habitat is very limited. This condition is worsened during low water years. There is a more detailed account of habitat and stream channel conditions for WRIAs 44 and 50 in *WRIA 44/50 Final Phase 2 Basin Assessment, April 2003*, for Foster Creek Conservation District by Pacific Groundwater Group with Montgomery Water Group and R2 Resource Consultants.



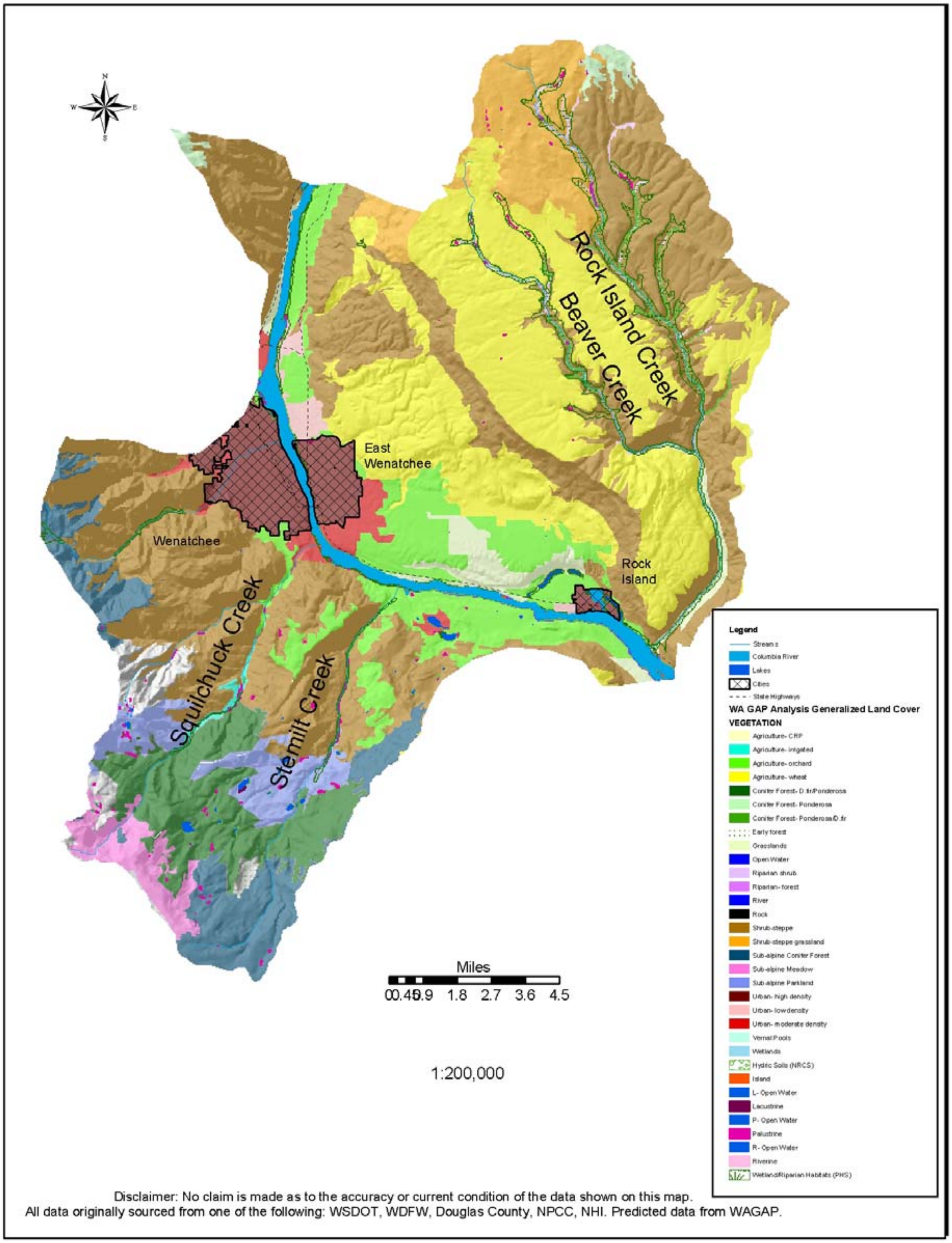
(DCTLS 2004)

Figure 40 Tributaries and land cover in the UMM Subbasin from Wells Dam to Chief Joseph Dam



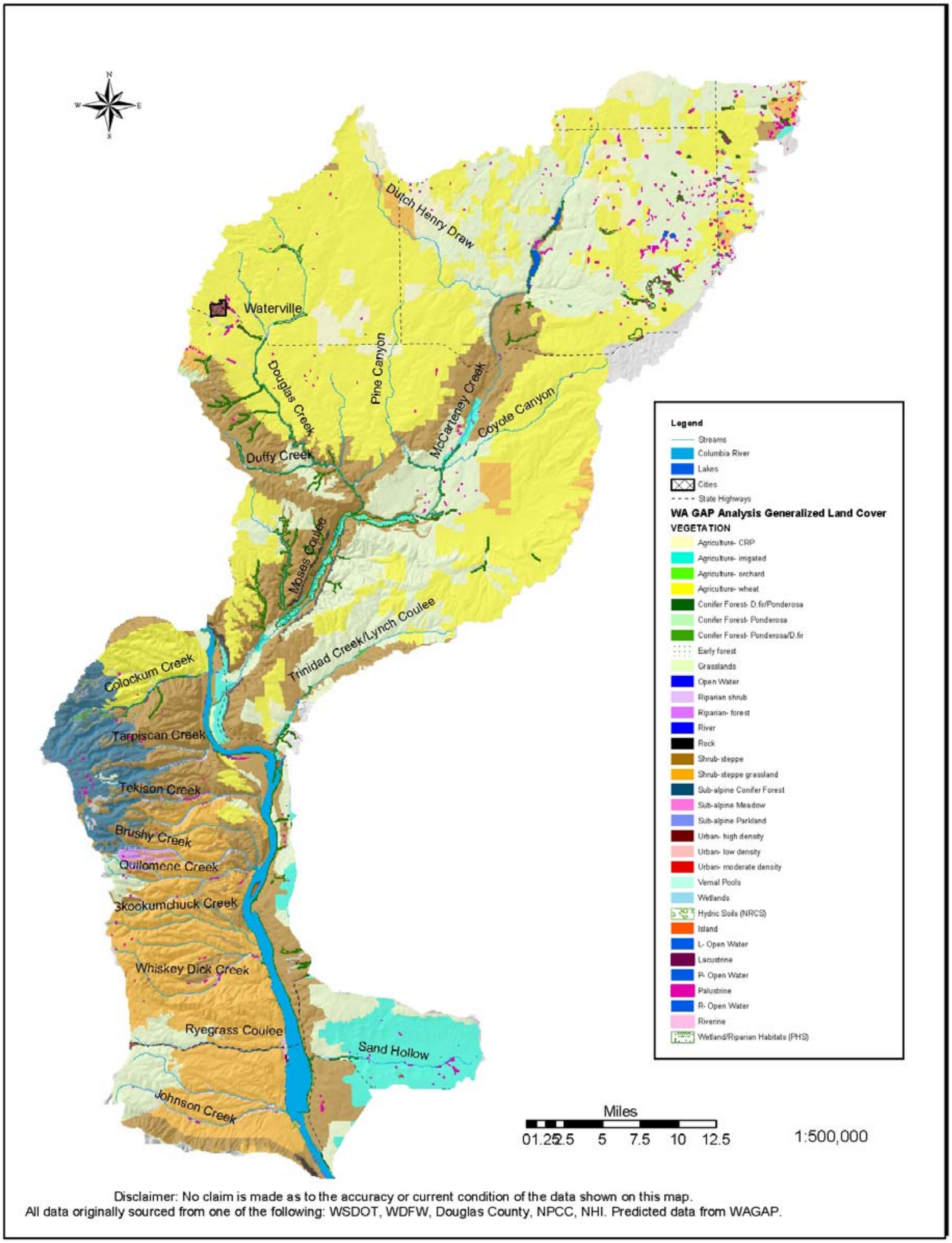
(DCTLS 2004)

Figure 41 Tributaries and land cover in the UMM Subbasin, from Rocky Reach Dam to Wells Dam



(DCTLS 2004)

Figure 42 Tributaries and Land cover in the UMM Subbasin, from Rock Island Dam to Rocky Reach Dam



(DCTLS 2004)

Figure 43 Tributaries and land cover in the UMM Subbasin, from Wanapum Dam to Rock Island Dam

QHA Model

A QHA model (Mobrand, QHA Model, 2003) was used to compare current aquatic and riparian habitat conditions in relation to the habitat requirements of all life stages of rainbow/steelhead trout (*Onchorynchus mykiss*) and Chinook salmon (*Onchorynchus tschawytscha*), with both known and assumed historical habitat conditions on 15 small tributaries in the UMM Subbasin. The QHA facilitates a structured ranking of stream reaches and attributes (Table 25) for subbasin planners. Information used in the analysis was obtained from documents, site visits, field sampling, expert opinion, and speculation.

Many of the small tributaries to the UMM are remote and very little information exists concerning these tributaries. Rigorous field investigations were not conducted because of insufficient funds. Most frequently the expert knowledge of subbasin planners was relied upon to describe physical conditions in the target stream and to create a hypothesis about how well the present habitat conditions provide for the needs of a focal species.

The synopsis of the streams/watersheds (see Environmental Conditions) was based on the QHA analysis and available sources, such as the limiting factors analyses (LFA) and local watershed assessments. The assessments were greatly enhanced by some recent Grant County PUD data acquired through their relicensing process, Foster Creek Conservation District's work in the 2514 Watershed Planning Process, and WDFW staff acquiring data through site visits.

A hypothesis was then created to describe/define how well the present habitat conditions provide for the needs of a focal species. The hypothesis is the "lens" through which physical conditions in the stream are viewed. The hypothesis consists of weights that are assigned to life stages and attributes, as well as a description of how reaches are used by different life stages. These result in a composite weight that is applied to a physical habitat score in each reach. This score is the difference between a rating of physical habitat in a reach under the current condition and the condition of the reach for the attribute in a reference (historical) condition. The result is that the current constraints on physical habitat in a stream are weighted and ranked according to how a focal species might use that habitat.

The attributes are rated for reference (undisturbed or normal) and current conditions and weighted for the effect on a particular life stage survival and capacity- spawning, rearing, and migration. Migration considers both adult and juvenile life stages. Weighting is derived for each habitat attribute in the reference and current conditions using a primary environmental attribute and an associated modifier. For example, the habitat attribute channel stability has a primary environmental attribute of bed scour, and three modifiers- icing, riparian function, and wood.

Table 25 Habitat attributes in the QHA Model

Riparian Condition	Condition of the streamside vegetation, landform and subsurface water flow.
Channel Stability	The condition of the channel in regard to bed scour and artificial confinement. Measures how the channel can move laterally and vertically and to form a "normal" sequence of stream unit types.
Habitat Diversity	Diversity and complexity of the channel including amount of large woody debris (LWD) and multiple channels.
Fine sediment	Amount of fine sediment within the stream, especially in spawning riffles.

Riparian Condition	Condition of the streamside vegetation, landform and subsurface water flow.
High Flow	Frequency and amount of high flow events.
Low Flow	Frequency and amount of low flow events.
Oxygen	Dissolved oxygen in water column and stream substrate.
Low Temperature	Duration and amount of low winter temperatures that can be limiting to fish survival.
High Temperature	Duration and amount of high summer water temperature that can be limiting to fish survival
Pollutants	Introduction of toxic (acute and chronic) substances into the stream.
Obstructions	Natural or man-made barriers- documented as to which type.

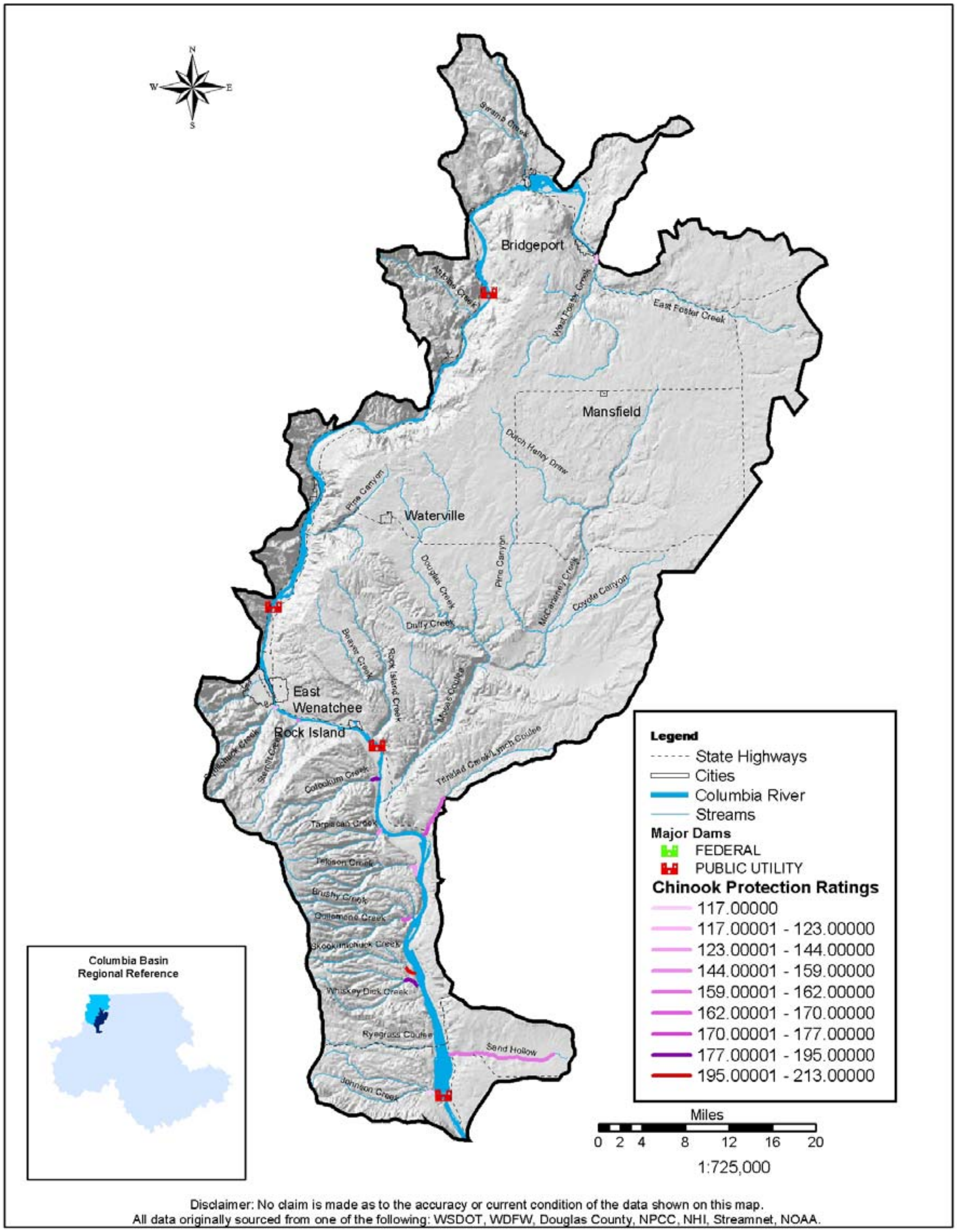
Grazing management plans or schemes were not assessed as a part of the tributary analysis. Substrate data discussions from WDFW collected information gathered during summer 2004 were based on visual observations, not a quantified data analysis process.

Rainbow trout/steelhead and Chinook were modeled using QHA. For the descriptions below, the term “rainbow trout” is used to represent both forms of that species (resident and anadromous). The stream descriptions include the number of acres per watershed or sub watershed (reach) if available based on HUC 6, USGS data to follow drainage basin boundaries, but truncated and estimated where boundaries crossed into two reaches identified in the QHA process (does not match WRIA boundaries). A description of the streams and reaches for the UMM Subbasin used for our analysis can be found in Figure 49 Comparison of ranked Steelhead/rainbow trout QHA protection and restoration scores for the UMM Subbasin, WA.

Table 26. Stream lengths were estimated using the length of perennial and intermittent flow (ephemeral upper sections were not included); therefore the drainage area lengths may be much longer than the stream lengths.

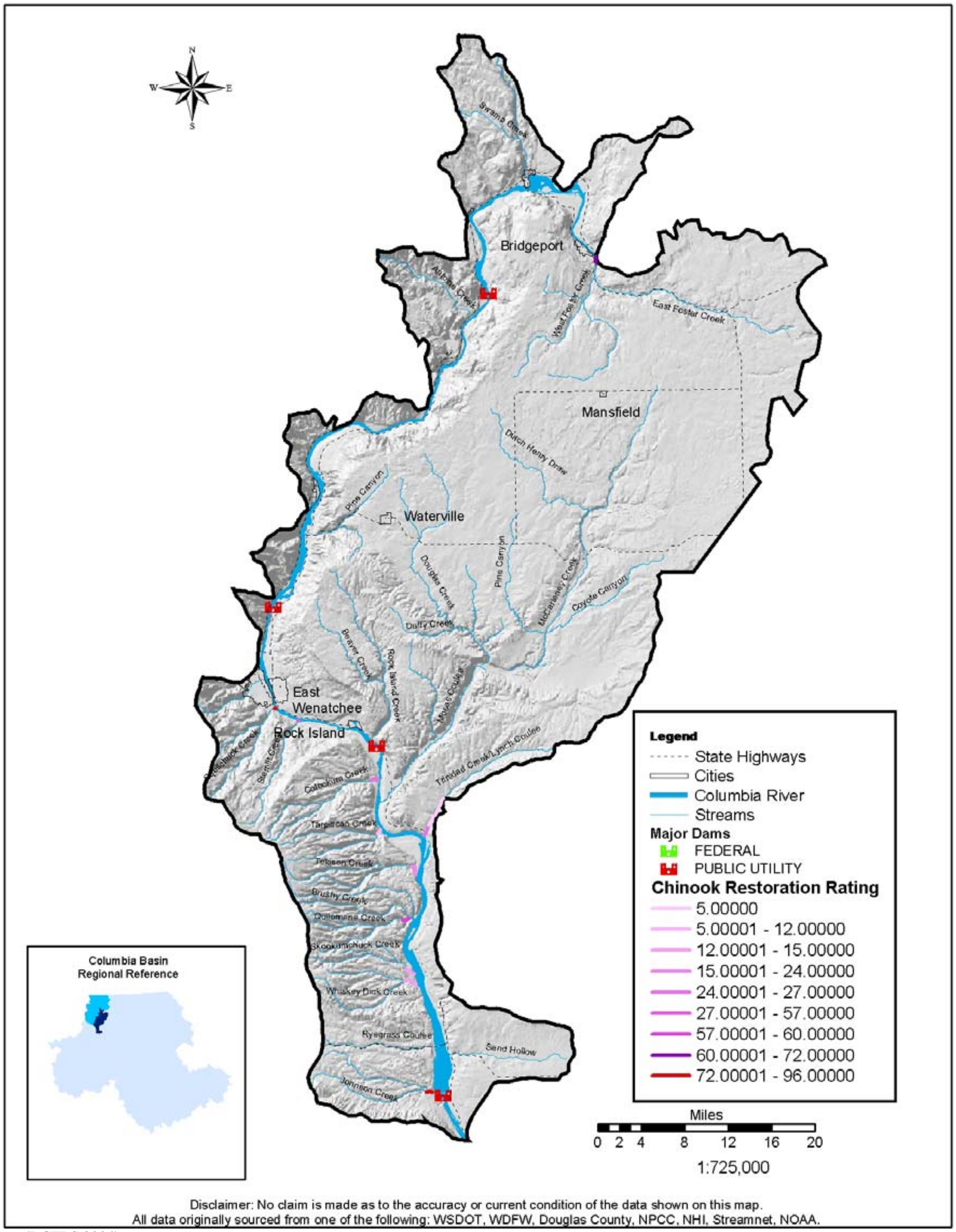
Ranked protection and restoration scores (Figure 44 - Figure 47) produced by the QHA and the relationship between these scores (Figure 48 and Figure 49) need to be considered along with the description of watershed attributes described for each tributary (Figure 49 Comparison of ranked Steelhead/rainbow trout QHA protection and restoration scores for the UMM Subbasin, WA.

Table 26) in the following section. The range of values for comparison purposes for steelhead are protection 120 to 213, restoration 6 to 117, and for Chinook protection 117 to 213, restoration 4.5 to 96.



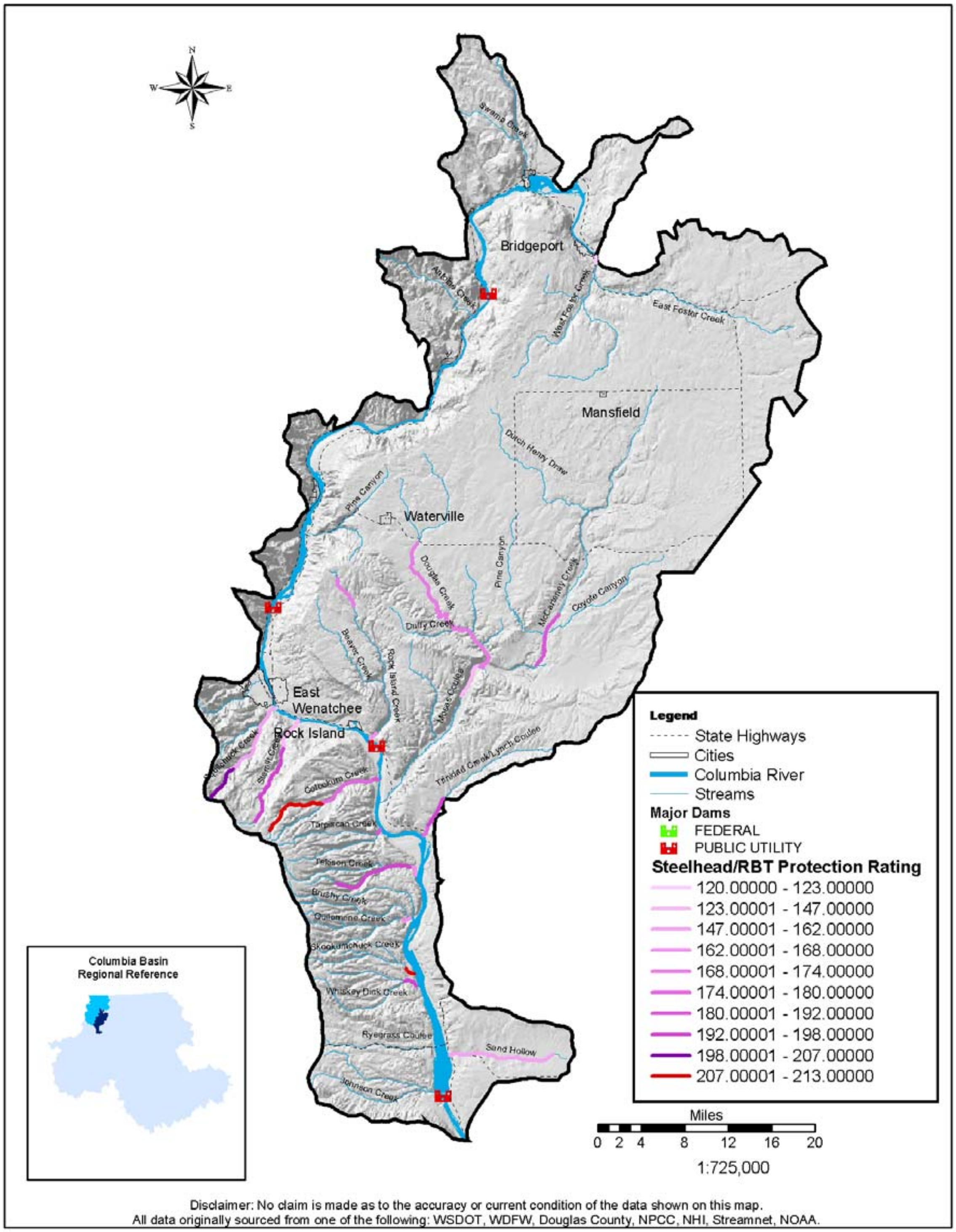
(DCTLS 2004)

Figure 44 Ranked Chinook QHA protection scores in the UMM Subbasin, WA.



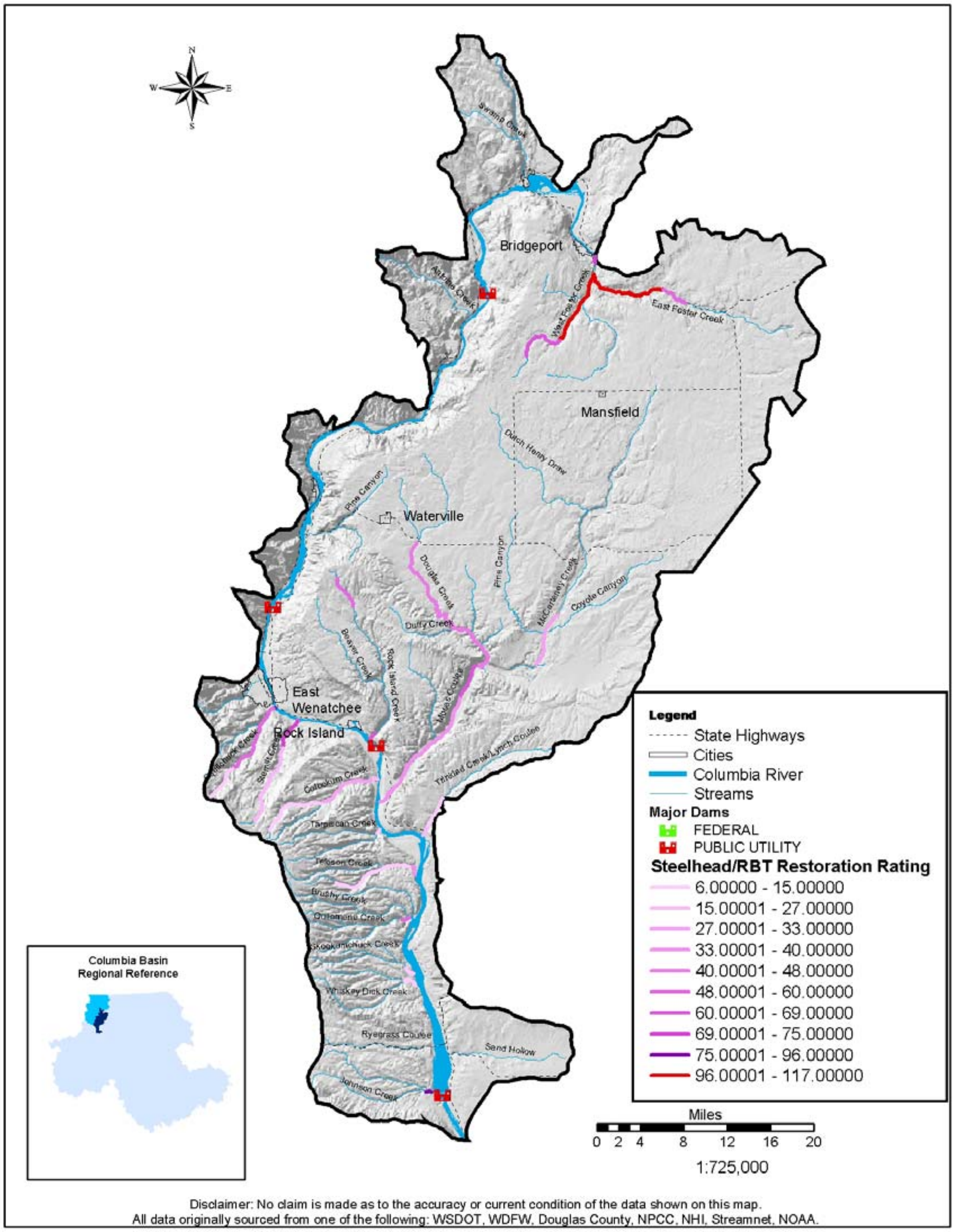
(DCTLS 2004)

Figure 45 Ranked Chinook QHA restoration scores for the UMM Subbasin, WA.



(DCTLS 2004)

Figure 46 Ranked steelhead/rainbow trout protection scores for the UMM Subbasin, WA.



(DCTLS 2004)

Figure 47 Ranked steelhead/rainbow trout restoration scores for the UMM Subbasin, WA.

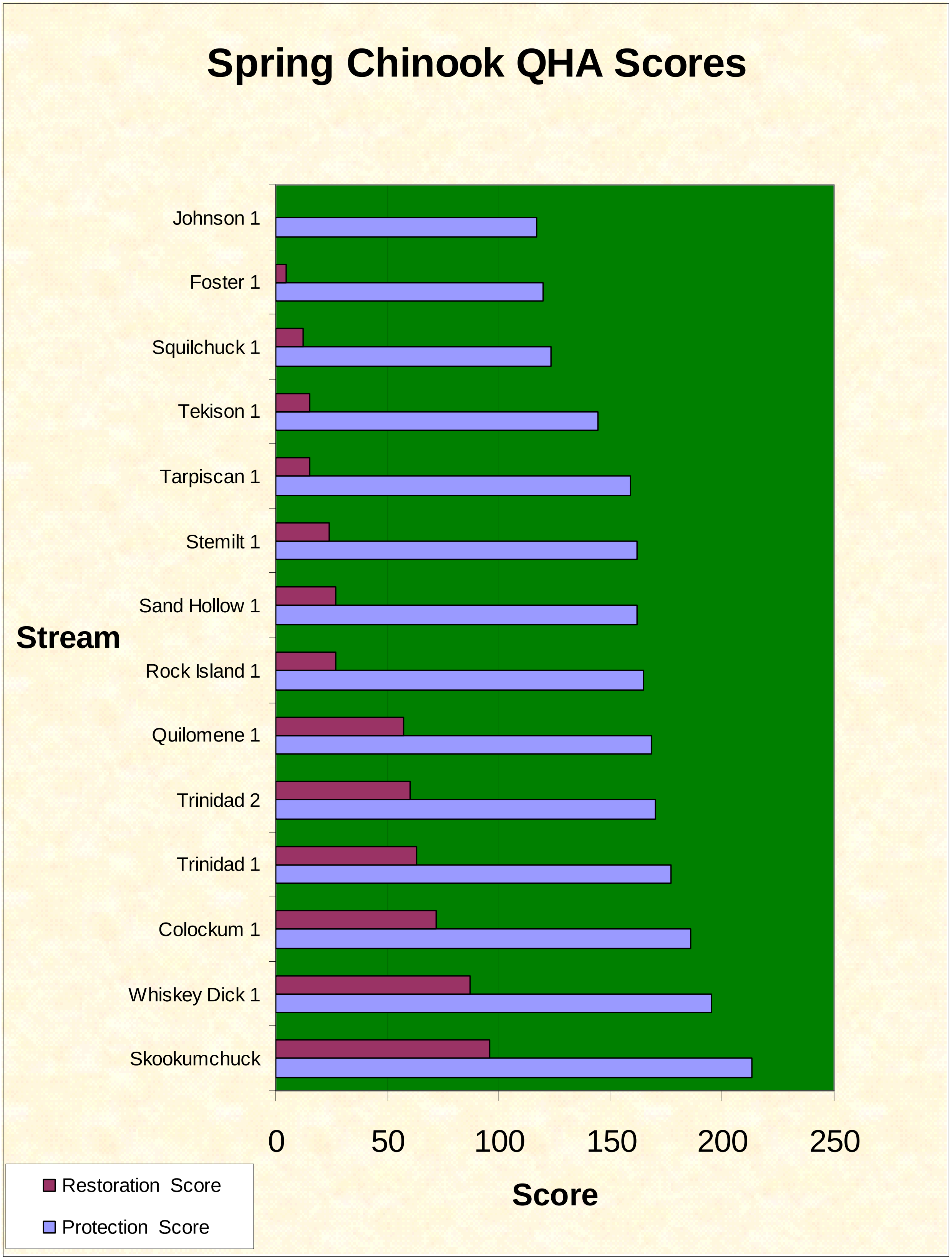


Figure 48 Comparison of ranked Chinook QHA protection and restoration scores for the UMM Subbasin, WA.

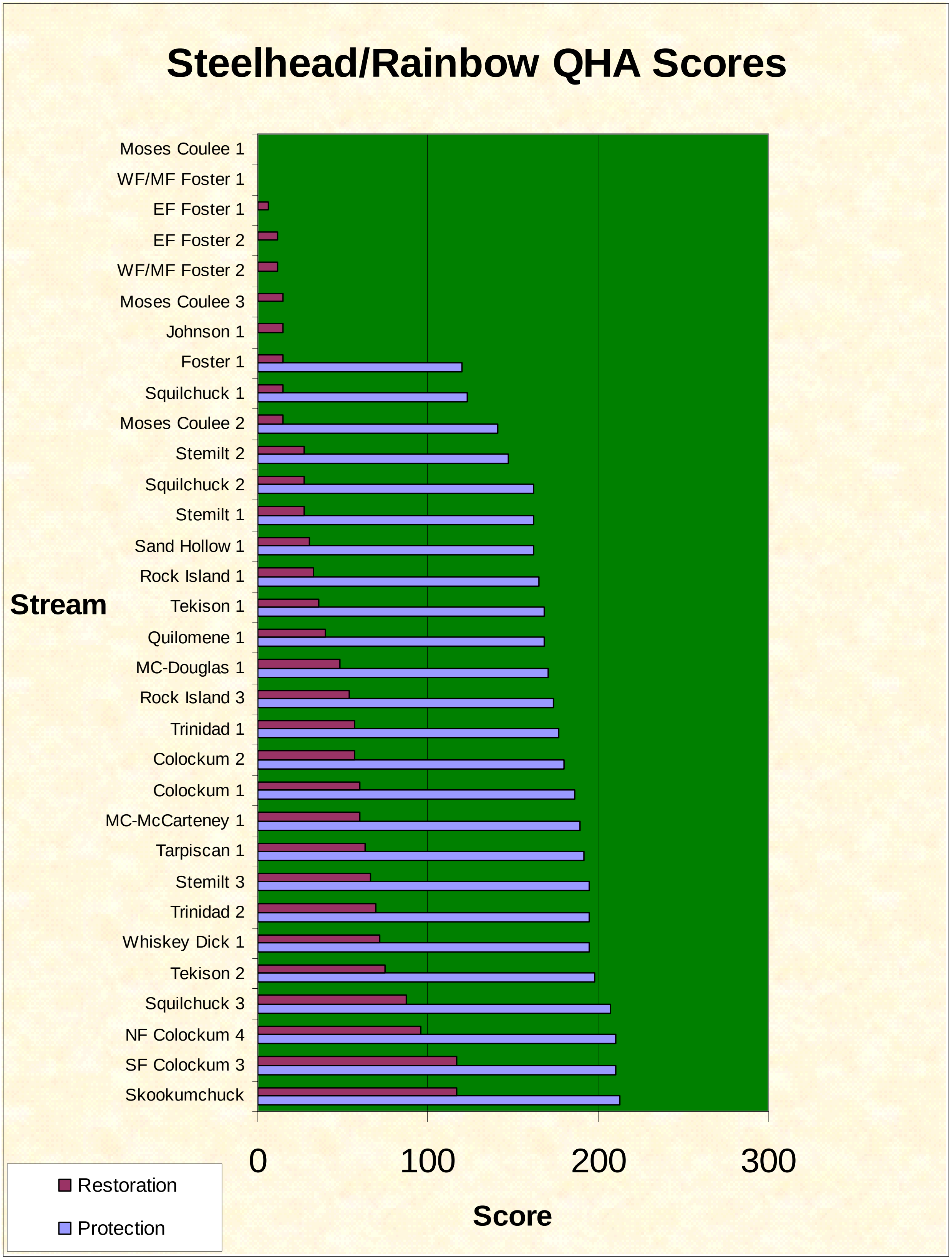


Figure 49 Comparison of ranked Steelhead/rainbow trout QHA protection and restoration scores for the UMM Subbasin, WA.

Table 26 Watershed attributes of streams in the UMM Subbasin, WA.

Stream/watershed	Reaches	Reach Length	Elev Low	High Elev	Acres	Public Acres	% Public
Brushy Creek	Brushy	1.5	599	5,056	13,335	8,812	0.66
Colockum Creek	Colockum	6.6	570	5,053	14,288	7,732	0.54
	SF-Colockum	4.7	2,161	5,761	4,596	3,365	0.73
	NF-Colockum	6.4	2,147	5,818	6,360	4,525	0.71
Foster Creek	Foster	1.8	780	2,616	4,244	757	0.18
	EF Foster	12.3	1,019	2,610	114,615	25,812	0.23
	WF Foster-Includes mainstem above barrier	13.6	1,021	3,175	39,524	7,486	0.19
	MF Foster		1,448	3,113	55,538	303	0.01
	New Foster		780	2,616	2,051	115	0.06
Johnson Creek	Johnson	5.5	591	3,745	38,610	38,344	0.99
Moses Coulee	Moses Coulee	25.7	582	3,600	139,507	75,738	0.54
	Douglas	19.4	1,020	4,173	131,067	22,123	0.17
	McCarteney	19.3	1,174	3,181	321,721	54,483	0.17
Pine Canyon Creek	Pine Canyon	12.0	705	5,325	21,500	1,720	0.08
Quilomene Creek	Quilomene	7.9	603	4,404	15,387	11,003	0.72
Rock Island Creek	Rock Island	18.6	610	4,247	54,822	6,076	0.11
Sand Canyon Creek	Sand Canyon	7.2	608	3,420	3,130	94	0.03
Sand Hollow Creek	Sand Hollow	10.4	569	1,895	35,518	2,085	0.06
Skookumchuck Creek	Skookumchuck	2.1	583	3,660	9,461	3,587	0.38
Squilchuck Creek	Squilchuck	11.5	616	6,802	17,554	4,694	0.27
Stemilt Creek	Stemilt	11.2	607	6,723	21,100	12,291	0.58
Tarpiscan Creek	Tarpiscan	.5	735	5,621	8,180	5,313	0.65
	NF-Tarpiscan	5.7	735	5,621	8,180	5,313	0.65
	SF-Tarpiscan	5.1	734	5,431	7,225	3,722	0.52
Tekison Creek	Tekison	9.2	570	5,456	21,138	14,784	0.70
Trinidad Creek (Lynch Coulee)	Trinidad	4.6	574	2.884	38,926	4,325	0.11
Whiskey Dick Creek	Whiskey Dick	4.0	572	3,867	21,904	14,806	0.68

Brushy Creek

The Brushy Creek Watershed, located in Kittitas County, contains approximately 13,335 acres, of which 66% is publicly owned. Data indicate that steelhead have used the bottom 0.8 miles for migration, the next 0.3 miles for rearing and migration habitat, the next 6.1 miles for spawning and rearing, and finally the last 0.5 miles for rearing and migration (Streamnet 2003).

Two reaches to be used in the QHA model were established on Brushy Creek. Reach 1 extends from the confluence with Quilomene up-stream to RM 1.46. Reach 2 begins at RM 1.46 and extends to the headwaters. Reach 2 was not surveyed because of its remote location. Although reaches were established, values for protection and restoration were not completed on Brushy Creek during the planning process.

Riparian Conditions

As its name implies, both banks of the lower mile of Brushy Creek are densely covered with vegetation common to the area. WDFW staff speculate that the riparian vegetation currently found on this reach is similar to what occurred historically.

Channel Conditions and Diversity

Channel characteristics in Reach 1 remain very similar to historic conditions, but may have been degraded by the excessive cattle grazing that took place in the 1900s (Paschal, pers. comm., 2003).

Fine Sediments

On July 14, 2003 WDFW sampled substrates in Reach 1, we found heavy to moderate siltation. Currently we are unsure of historical substrate conditions but speculate that historical silt loads in the creek were less than currently exits. The existing accumulation of silt is likely a result of historic cattle grazing.

Water Quantity and Quality

WDFW recorded water temperature and DO measurements of 69^0F and 7.5 ppm, respectively (July 14, 2003 at 2:15 P.M). Water flows were judged to be relatively good (50% bank full) for that time of year. Water flow, water temperature, and DO concentrations in Reach 1 were within tolerance limits for both juvenile Chinook and rainbow/steelhead. Currently no information is available concerning year-round daily water temperatures, DO levels, or water quality. Cattle grazing and agricultural practices are assumed to only marginally affect water quality.

Colockum Creek

The headwaters of Colockum Creek lie in the upper reaches of the southernmost extent of Naneum Ridge. Colockum Creek flows in an easterly direction from its headwaters for approximately 12 miles before entering the Columbia River (RM 450.0) fifteen miles downstream of the Wenatchee River confluence. Elevation ranges from 5,600 along Naneum Ridge to 650 feet at the mouth. All of the lower 7.5 miles of stream flows through private land. Colockum Road parallels the stream channel for the first 6 miles.

It is presumed that historically salmon were present only in the lowest reach of Colockum Creek and steelhead/rainbow trout would have been distributed throughout the watershed where habitat was accessible (Steele, pers. comm., 2000; Viola, pers. comm., 2004).

Based on electro-fishing results rainbow/steelhead presently occur from the mouth upstream to Kingbury Canyon (RM 3.8; Steele, pers. comm., 2001). It is assumed that at this time rainbow/steelhead are distributed throughout the watershed where low flows, natural barriers and human-made fish passage barriers do not preclude access to habitat. In 1999 Grant County Public Utility District (GCPUD) surveyed the lowest reach and found several species of fish present; rainbow trout, Chinook salmon, threespine stickleback, chiselmouth longnose dace, and cottids.

There is no published information available on habitat conditions or land use affects on aquatic habitat in the Colockum Creek watershed. There were no culvert fish passage barriers identified in the Harza/Bioanalysts (2000) fish passage barrier inventory, however irrigation diversion structures in the drainage may hinder or block fish passage at some flows (Steele, pers. comm., 2001). These structures have not been evaluated for fish passage concerns (Andonaegui 2001).

For use in the QHA Model, Colockum Creek was divided into four reaches; the mouth to a large gradient change (RM 0.76), from RM 0.76 to the confluence of the north and south forks (RM 6.58), and each of the two forks to the headwaters (NF-6.43 miles, SF- 4.7 miles).

Riparian Conditions

Riparian vegetation on Colockum Creek is, in general, dense and brushy. However, some areas particularly in the middle and lowest reaches have been negatively altered by residential and agricultural activities and road crossings. Vegetative species change with elevation. The upper reaches are dominated by forest vegetation common to the area. Brushy species dominate and the middle reach and riparian vegetation in the lowest reach contains sage and bitter brush.

Channel Condition and Diversity

Present channel condition and diversity in the lowest reach of Colockum Creek has not been thoroughly surveyed; more investigation is needed. The middle reach has been altered substantially by road development, which includes a number of stream crossings. The current channel condition and diversity in reaches 3 and 4 also have been altered by road construction and bridge crossings but to a much lesser degree than the middle reach. Portions of both reach 3 and 4 are unaltered and assumed to be in similar conditions as occurred historically.

There were no culvert fish passage barriers identified in the Harza/Bioanalysts (2000) fish passage barrier inventory, however irrigation diversion structures in the drainage may hinder or block fish passage at some flows (Steele, pers. comm., 2001; Viola, pers. comm., 2003). An irrigation diversion structure located approximately 1.0 mile up Colockum Creek may block fish passage at low flows (Steele, pers. comm., 2001). These structures have not been evaluated for fish passage concerns. Colockum Creek was adjudicated in 1913 with no provisions for maintaining instream flows; certified water rights appear to exceed available surface flow on an annual basis (Monahan, pers. comm., 2001).

Fine Sediments

On July 14, 2003 WDFW briefly sampled substrates in Reaches 1, 2 and 3 of Colockum Creek. We found heavy to moderate siltation in Reaches 1 and 2 and minor siltation in Reach 3. Currently we are unsure of historical substrate conditions but speculate that silt loads in the stream were less than currently exits. The current accumulation of silt is likely a result of agricultural practices and possible historic cattle grazing. Reach 4 was surveyed about a week later and found to be dry, making it difficult to determine substrate characteristics.

Water Quantity and Quality

Average annual precipitation is relatively low with precipitation rapidly decreasing with declining elevation. Runoff comes predominantly from melting of accumulated snow from April through July. Perennial stream channels are limited in this watershed and intermittent flows occur regularly in the upper reaches. Also the stream flow goes subsurface in many sections of the upper reaches. Year-round water quality is unknown. WDFW speculates that cattle grazing and agricultural practices only marginally affect water quality.

WDFW recorded identical water temperature and DO measurements of 62^0F and 8.0 ppm, in reaches 2 and 3 (1:00 P.M.) on the July 14, 2003 site visit to Colockum Creek. Water flows were very low. Water flow under normative conditions is not ideal for fish use, but it has also been altered by water diversions from the normative conditions (LFA- Andonaegui, 2001). WDFW also recorded water temperature and DO measurements of 70^0F and 7.0ppm (4:00 P.M.), respectively, in Reach 1 (Viola, pers. comm., 2003), which slightly exceeds tolerance limits for both juvenile steelhead and Chinook. Currently no information is available concerning year-round daily water temperatures or DO levels. Due to the remote location of Reach 4, it was not surveyed until a week later and was found to be dry.

QHA Results

Reach one was modeled for both rainbow trout and Chinook salmon (Table 27) and the remaining reaches for rainbow trout only, as there is no documentation of Chinook occurring that far up in the watershed because of steep gradient and insufficient flow. Colockum Creek water quality in all reaches is unknown, but minor contamination may occur because of livestock grazing.

The analyses and ratings for Reach one are the same for both species and have a substantially higher protection rating compared to the restoration rating. In all of the reaches the rainbow trout model depicts high protection ratings when compared to the rest of the tributaries in the Subbasin.

Table 27 QHA habitat scores for Colockum Creek

Reach	Species	Protection Score	Restoration Score
Colockum 1	Chinook	186	27
Colockum 1	Rainbow/steelhead	186	27
Colockum 2	Rainbow/steelhead	180	33
SF-Colockum 3	Rainbow/steelhead	210	12
NF-Colockum 4	Rainbow/steelhead	210	12

Foster Creek

The Foster Creek Watershed is located close to the geographic center of Washington State in the “Big Bend” area of the Columbia River. The watershed drains approximately 214,103 acres in northern Douglas County. There are three main tributaries, Lower (2,311 acres), East (115,872 acres), and West Foster Creek (105,580 acres) that converge and flow northward emptying into the Columbia River downstream of Chief Joseph Dam (Columbia River Mile 545.1) near the town of Bridgeport.

The Foster Creek watershed provides limited habitat for fish. Loss of access to spawning and rearing habitat on Foster Creek was identified as a potential limiting factor for migrating fish. At approximately river mile (RM) 1.03 an irrigation dam stands in a place where a natural falls existed. The irrigation dam is 18 inches taller then the original falls that precluded all fish passage past this point. Surveys have been conducted in the stretch of water upstream of this dam and no anadromous salmonid species were found. Low water flows and direct solar exposure also make it questionable whether or not salmonids could survive in this stretch if given access to it. The lower 1.03 miles of Foster Creek may be blocked off to anadromous salmonids during extreme low flow years because of a 1989 flood that deposited a large gravel bed and reshaped the alluvial fan at the mouth and the channel throughout the reach. The mouth of Foster Creek has also been channelized and rip rapped with rock and wire mesh.

Riparian Condition

Poor quality riparian habitat in the Foster Creek and East Foster Creek drainages may also be a limiting factor for fish. East Foster Creek and Foster Creek above the dam lack large woody vegetation and in several places only the trunks of dead streamside trees are standing.

Channel Condition and Diversity

The stream reach inventory/channel stability evaluation conducted in 2002 indicates a good rating (71 points) for reach one of Foster Creek (PGG et al. 2003).

Fine Sediments

Foster Creek was assessed by R2 Consultants, for Foster Creek Conservation District and found the lowest reach had fines <6mm of 20% in 2002 (PGG et al. 2003).

Water Quantity and Quality

Water quality monitoring has been conducted in the East Foster Creek drainage. Various soil and water problems were identified in this area. Eroding stream banks, channel head cutting, and non-point-source fluvial erosion of croplands and rangelands have all contributed increased turbidity in the stream. Erosion problems occur because of fine-grained soils susceptible to erosion, intense rainfall, or sudden snowmelt.

The Foster Creek drainage receives little yearly precipitation with most occurring during winter months. In the winter, runoff is high and the water is extremely muddy, carrying increased sediment loads associated with loss of riparian vegetation. Some years there are perennial flows in some streams, but this hydraulic continuity is unlikely year-round.

Aside from spring snowmelt, flows in the Foster Creek are generally sustained by groundwater discharge from springs. Intense summer storm events also add to summer flows and some sections of the stream have sub-surface flow. This could restrict any possible dilution of chemical contaminants. It is possible that certain chemical products such as naturally occurring salts and organic materials as well as non-natural substances such as pesticides and herbicides may appear in high concentrations in Foster Creek because of the limited precipitation and flows.

Evidence of contamination, if any in Foster Creek however, is not well documented or not available.

Salmonid productivity may also be negatively affected by warm water temperatures from low flows, arid climates, and lack of riparian shading. The extent to which human activities may exacerbate this condition is unknown. Presently, it is the conclusion of the TAG and landowners that although there are human impacts in the Foster Watershed, these impacts have a very limited affect on anadromous salmonid spawning and rearing use given the natural limitation imposed on the habitat by the arid, shrubsteppe ecosystem.

QHA Results

Foster Creek was sectioned into five reaches: the mouth up to the falls/dam, two reaches in the east fork, and two reaches in the west/middle fork. Overall, the analysis of Foster Creek depicted values higher for restoration than protection (Table 28). The habitat conditions of riparian area, channel stability, diversity, and sediment were fair to poor overall. Water quality, while impaired, does not appear to be as degraded as the physical habitat features. There is a barrier to migration at the end of the first reach, but all of the reaches were modeled for rainbow trout because of the watershed condition and cumulative effects to the lowest reach (i.e., the upstream characteristics appear to be having a larger effect on the first reach, than current conditions indicate). In addition, the resident form of *O. mykiss* could exist above the migration barrier. The lowest reach was also analyzed for Chinook, and the result is nearly identical to that of rainbow trout. No thorough fish surveys have been conducted on the upper reaches to date, but water quality/ quantity and habitat data have been gathered within the last two years or are monitored on an ongoing basis. Reach one has a higher protection value than restoration based on the analysis, but the remaining reaches all have high restoration values compared to most of the streams in the subbasin. Protection values in the upper reaches are zero because the current condition shows no use by the focal species.

Table 28 QHA habitat scores for Foster Creek, Washington

Reach	Species	Protection Score	Restoration Score
Foster 1	Chinook	120	72
Foster 1	Rainbow/steelhead	120	72

Johnson Creek

The Johnson Creek Watershed, located in Kittitas County south of Interstate 90, contains approximately 39,178 acres and is approximately 14 miles in length. Ninety-nine percent of Johnson Creek is located on Public Land (U.S. Army Yakima Training Center, formally Yakima Firing Range). Only the lowest half-mile of stream is privately owned. In 1999 GCPUD surveyed the lowest reach and found several species of fish present; rainbow trout, Chinook salmon, chiselmouth, cottids, largescale sucker, and threespine stickleback. Other data indicate that steelhead have used the bottom 1.6 miles for migration and rearing and fall Chinook for migration (Streamnet 2003). Grant County PUD also found that the population of rainbow trout in this stream might be unique.

Two reaches were established for use in the QHA model. Reach 1 extends from the mouth upstream to RM 0.5. Reach 2 extends from RM 0.5 to the headwaters. We separated these reaches based on ownership. Reach 1 is privately owned, while Reach 2 runs through the U.S Army Yakima Firing Range and has restricted access. Consequently, only Reach 1 was sampled.

Riparian Conditions

On August 18, 2003 WDFW made a cursory survey of Johnson Creek. The riparian zone in Reach 1 of Johnson Creek was extremely degraded compared to assumed historic conditions, and was far more damaged than any other surveyed stream in the UMM Subbasin. Both banks have had most, if not all, of the vegetation removed, leaving only dirt banks. It is believed this was the result of actions taken to clear the site for the current private campground.

Channel Conditions, Diversity, and Fine Sediment

The stream channel has been greatly altered compared to assumed historic conditions. In some places the channel has been straightened, moved, and confined between dirt berms. A deep hole has been dug in the channel to act as a small pond. The lower ¼ mile of stream has been inundated by the Columbia River because of the construction of the Wanapum Dam. A road bridge confines the lowest section of the stream channel. A considerable amount of silt was found in the substrate in Reach 1.

Water Quantity and Quality

Because of complicating circumstances no water quantity or quality samples were taken during WDFW's site visit. More information is needed on year–round flows, water temperatures, and DO concentrations. A comprehensive study of water quality is needed to determine if agricultural or any other chemical contaminants are present at levels that would reduce aquatic system productivity.

QHA Results

Both Chinook and rainbow trout were used in the assessment model (Table 29), although the assessment was only done for Reach one; Reach two is inaccessible because of its location on the Yakima Firing Range. Rainbow trout showed no protection value because the current conditions were not assigned numerical values in the hypothesis section (assessment error). The protection and restoration values for Chinook are misleading; this section of stream is in dire need of restoration for both Chinook and rainbow/steelhead. Riparian and habitat conditions were rated as poor and flow issues, mostly related to natural conditions within the watershed, were identified.

Table 29 QHA habitat scores for Johnson Creek, WA.

Reach	Species	Protection Score	Restoration Score
Johnson 1	Chinook	117	87
Johnson 1	Rainbow/steelhead	Missing	Missing

Moses Coulee

The Moses Coulee Watershed drains approximately 592,833 acres. Moses Coulee extends southwest from central Douglas County before emptying into the Columbia River (Columbia R M 447.0). For subbasin planning the watersheds described include Moses Coulee (including

Rattle Snake Creek, 139,844 acres), Douglas Creek (131,015 acres) and McCartney Creek (321,974 acres). This watershed is one of few in the state with almost no forested areas. It is almost entirely shrubsteppe and agriculture (>99%).

Three streams with a total of six reaches were examined for Moses Coulee. Moses Coulee was broken into 3 reaches: the mouth to where the water flow begins near Palisades, the flowing reach to Douglas Creek, and the area from Douglas Creek to McCartney Creek. The other reaches are Douglas Creek, and two reaches in McCarteney Creek, of which the upper reach is dry throughout most years. All flowing reaches contain fish, including rainbow trout, but no thorough surveys for species composition and population estimates have been done. Some investigations using electroshocking techniques have occurred in the past (Bartu and Andonaegui 2001).

Riparian Condition

Riparian habitat is degraded or lacking in many parts of the Moses Coulee watershed. The lowest reach of Moses Coulee has a channel, but no riparian area as water only flows during extreme flood events (about once every 10-20 years). Reach two is confined and has a limited riparian area that receives water from Douglas Creek. Reach three is above Douglas Creek and has no functional riparian area. Agricultural field development and flood control dikes that capture sediment and energy during extreme events have altered much of that reach. The channel, where it exists, is mostly maintained as a ditched waterway that is dry nearly as much as the lowest reach, under natural conditions. Douglas Creek reaches have fair riparian condition in several areas, although plant composition has many non-native species, such as Russian olive, black locust, and elm trees, orchard grass and knapweed. Reach one of McCarteney Creek has some fair to good riparian cover. Some of reach one has a naturally protected area as it flows between basalt cliffs, and some of the area, where it's open has had past uses of cattle grazing and crops. There also is an existing non-functional dam that filled in with sediment and has a larger area of wetland/riparian area. Reach two of McCarteney Creek has no riparian area and only flows during extreme flood events.

Channel Condition and Diversity

A natural falls barrier in Douglas Creek hinders upstream fish migration. Rainbow trout, dace, sculpins, and sucker populations are present in the Palisades section and upstream and flourish in a hostile environment: low flows (summer & winter); heavy soil loads from dryland tillage (Waterville Plateau); and infrequent, torrential, floods (Quinn 2001a). Rearing Chinook salmon have been found near the mouth (MR 0-0.1) (WDFW file data) when subsurface flows, during wet weather cycles (several years), are sufficient to come to the surface where the channel gradient drops to the Columbia River.

Rainbow trout are found in McCarteney Creek, likely from private stockings, but have been known since at least 1968 (WDFW file data). Other species may be present, but thorough fish surveys have not been done (Quinn 2001b).

The stream reach inventory/channel stability evaluation conducted in 2002 indicates a fair rating (78 points) for the very lowest section of reach one of Moses Coulee (PGG et al. 2003).

Fine Sediments

No data is available for substrate composition within the Moses Coulee watershed. In the WRIA 44 Basin Technical Assessment, only streams with anadromous salmon potential were surveyed for channel conditions (Dudek, pers. comm., 2004).

Water Quantity and Quality

The substrate of Moses Coulee Creek is often rocky and porous. As a result, runoff that enters the coulee tends to quickly disappear into the stream's floor and permanent flows within upper Moses Coulee are not found until just north of Rim Rock Meadows. McCarteney Creek begins at this point and flows for approximately 6.5 km until it disappears into the Moses Coulee floor.

Douglas Creek is a small stream receiving most instream flow from springs. Flow is southeasterly, into the steep canyon of Douglas Creek, where Duffy Creek, several small streams, and ground water accretion contribute to a permanent flow year round. In most years surface flows seldom reach beyond the Palisades area (Quinn 2001b). Two irrigation diversions are located approximately 0.25 miles from where the stream enters Moses Coulee. During the dry summer months, the lower reach is dewatered with flows either being diverted or going subsurface. Instream flows can intermittently return with a summer thundershower or during high spring run-off events, and the flow during those events can make it to the Columbia River.

Water quality sampling in Douglas Creek in 1989 revealed high levels of nitrates and phosphates. A large percentage of land in the watershed is routinely fertilized for agricultural use and fertilizers contain these two substances. Routine application of these chemicals as well as the arid climate allows for little dilution of the chemicals, which may account for the elevated levels observed in Douglas Creek.

QHA Results

Reach three of Moses Coulee had the highest restoration rating in the watershed (Table 30), which was derived from very low current habitat condition values compared to estimated normative conditions. The three reaches that have high protection ratings are those with continuous water flow: ratings high to low are McCarteney1, Douglas, and Moses Coulee2. Observation of some current land use patterns in these three reaches indicate that accessibility and land ownership patterns (public, private, non-profit) follow the current conditions and protection values. The land ownership is the highest for the private/non-profit status and McCarteney1 has the most restricted access.

Table 30 QHA habitat scores for Moses Coulee, WA.

Reach	Species	Protection Score	Restoration Score
Moses 2	Rainbow/steelhead	141	39.5
Douglas Creek 1	Rainbow/steelhead	171	48
McCarteney Creek 1	Rainbow/steelhead	189	30
Moses Coulee 2	Rainbow/steelhead	0	69

Pine Canyon (Corbaley Canyon)

The Pine Canyon subwatershed contains approximately 21,500 acres (33.6 sq. mi.) and is comprised of two stream reaches. The lower reach is 3.5 miles long and is dry and the upper wet reach is 8.5 miles. Although this stream was not evaluated and does not have access for anadromous fish, rainbow trout of unknown origin rear and spawn up to approximately RM 6 and there is potential for summer steelhead to use this stretch in years when instream flows are sufficient to allow upstream migration of spawning adults or downstream emigration of smolts (Bartu and Andonaegui 2001). Pine Canyon Creek is not accessible to anadromous fish because stream flows are subterranean across the alluvial fan and downstream of the SR 2 Bridge to the stream's confluence with the Columbia River (RM 0.00 to RM 1.23). The quality of the water and habitat is considered relatively good for aquatic production upstream of RM 1.23, but providing sufficient water volumes to allow anadromous fish passage across the alluvial fan appears problematic (PGG et al. 2003).

Historical evidence supports the prior use of Pine Canyon Creek by resident trout species, but not anadromous fish species (PGG et al. 2003). No other fish have been seen in the stream other than rainbow/steelhead trout (Bartu and Andonaegui 2001).

Riparian Condition

There is a dense riparian stand at the mouth of Pine Canyon Creek up to the SR 97 channel crossing (RM 0.25). There is little riparian habitat from RM 0.25 - 2.0 because of lack of water, and brushy riparian habitat consisting of willow, reed canary grass, service berry, pine, wild rose, and other species was found from RM 2.0 - 6.0, (Bartu and Andonaegui 2001). Riparian vegetation is abundant where surface water is present and generally lacking along the dry stream reach. Conditions observed in 1978 photos indicate there has been little change in the location or extent of riparian tree communities in the last quarter of a century (PGG et al. 2003).

Pine Canyon Creek was unique among the channels evaluated because it was the only area where conifer trees were a component of riparian communities. The most downstream portions of the stream are non-forested, but occasional conifers occur along north-and east-facing canyon walls in upper Pine Canyon Creek and its tributaries. A channel segment with scattered hardwood trees was mapped approximately 1.5 miles upstream of the confluence with the Columbia River. The prevalence of medium to large-sized trees indicates that there is a potential supply of large woody debris (PGG et al. 2003).

Trees within the riparian zone bordering the lower channel segment provide shade and represent a potential source of LWD. However, the density of residential and agricultural land uses on both sides of the stream likely limit the longevity of in-channel LWD and shade. Trees that could enter the stream and potentially form log jams or redirect flow or shade orchard trees are probably removed to protect humans and their property (PGG et al. 2003).

Channel Condition and Diversity

The lower reach of Pine Canyon Creek has a small but distinct alluvial fan composed of coarse, subangular sediments deposited as a result of very large floods. The channel gradient in this segment is 4.8 percent. Surface stream flows across the fan are spring fed and go dry/subsurface during the summer months, except during rain-on-snow events, spring run-off, or major storm events. No surface water was flowing on the alluvial fan channel segment downstream of SR 2

Highway bridge (RM 1.23) during all surveys conducted in 2001 and 2002 (Pacific Groundwater Group and Montgomery Water Group 2003). It is thought that the stream used to sustain year-round flows more often than currently (Bartu and Andonaegui 2001).

The pool-riffle reach (RM 1.23 to 1.62) is low to moderate gradient (1.0 to 2.5 percent). The habitat sequence is alternating pools and riffles with only one cobble step classified as cascade habitat. Pool habitat frequency was generally low; less than ten percent of the reach by length is composed of pool habitat. Although a spawning area survey for this stream reach was not conducted, stream bottom substrates were characterized as having a high composition of small to large gravel with occasional cobble accumulations. Channel substrates were generally clean (low percent fines) with silt or sand substrate dominant in only a few habitat units. Although pool habitat was limited, the abundance of available, clean gravel should be conducive to successful spawning and rearing and the production of key prey items for salmonid fishes (PGG et al. 2003).

The middle section of Pine Canyon Creek occupies a steep-sided bedrock canyon. The valley floor is approximately 500 feet wide, and is almost entirely filled with coarse sediment similar to that found on the alluvial fan. Flow across this sediment deposit is subsurface for much of the year. The gradient through this segment is greater than five percent. In fluvially dominated systems, such steep channels are generally able to transport sediment delivered from upstream reaches. The presence of extensive coarse sediment deposits suggests that the system is dominated by mass wasting processes or that a wave of fluvially deposited sediment may currently be working its way through the system (PGG et al. 2003).

At an elevation of around 1,600 feet, Pine Canyon splits into two main tributaries: Pine Canyon and Corbally Canyon creeks. Both of these channels occupy steep-sided V-shaped valleys with gradients in excess of 5 percent. These channels appear to be functioning as transport reaches and no large accumulations of sediment were noted (PGG et al. 2003).

The floodplain consists mostly of river wash that has been moved to form a more permanent channel. There is disconnected hydraulic continuity. The channel at the lower reach (RM 0.0-RM 2.0) consists of river wash and has been diverted to create a permanent channel. The middle reach (RM 2.0-RM 6.0) has a well defined channel, some significant pools, and a dense riparian canopy (Bartu and Andonaegui 2001).

Fine Sediments

Pine Canyon Creek has a unique geology for WRIAs 44 and 50; consisting of biotite gneiss. It supports high levels of mica and likely weathers to fine materials. The stream substrate changes from fine alluvium to bedrock to coarse alluvium as it flows towards the Columbia River. The stream looses water in the coarse alluvium section and is completely dry before reaching the Columbia River. High levels of fine sediment accumulations were not observed in the channel. This observation, in addition to the channel stability and pebble count survey data, suggests the stream is capable of transporting the fine materials. Spawning, rearing, and food production should not be compromised as a result of the fine sediment levels noted in the stream (PGG et al. 2003).

Water Quantity and Quality

Stream flows in the lower reaches (RM 0.0 to 1.23) of Pine Canyon Creek go subsurface and are rare. The last time there were surface flows through this reach was in 1996 because of high snowfall in the upper elevations of the watershed (Waterville Plateau) (Bartu and Andonaegui 2001). Stream flow monitoring at RM 1.62, during the summers of 2001 and 2002, indicates surface water flow between 0.2 and 0.4 cfs. The lowest flows were measured during the month of September. Upstream of the SR 2 Highway Bridge, small volumes of ground or hyporehic water are forced to the surface and flow was present throughout the summers of 2001 and 2002. This expression of surface water may be in relation to zones of shallow bedrock in the vicinity (PGG et al. 2003).

It is uncertain to what extent human land-use activities in the subwatershed may be exacerbating low flow conditions in lower Pine Canyon Creek (Bartu and Andonaegui 2001). It is B. Steele's professional opinion that in the past, perennial flows in the stream were more common and persisted longer into the season following spring snowmelt (WDFW, pers. comm., in Bartu and Andonaegui 2001).

Upper Pine Canyon Creek supports favorable water quality conditions for rearing fish. Data collected during the summers of 2001 and 2002 indicate relatively cool water temperatures (a result of significant springs and groundwater inflows), conductivity exceeding 600 µmhos/cm and pH levels within the Class A water quality criterion of 6.5 and 8.5 pH units (+/- 0.5 pH units). The waters are neutral to slighty alkaline in nature, which is typical of arid and semi-arid conditions. The data indicated relatively low to moderate abundance of organisms. Nevertheless, the stream supported high numbers of taxa and a high level of fish food items (EPT taxa). There was very little evidence of sediment accumulation influencing the benthic invertebrates, perhaps because of a combination of groundwater inputs and channel gradients, which are slightly steeper than in other local streams. The overall B- IBI rating of 31 for benthic invertebrates indicates relatively good water quality and habitat conditions exist for macroinvertebrate community development compared to the other streams surveyed. Lower Pine Canyon creek is not conducive to benthic invertebrate production because of the lack of surface water stream flow throughout the year (PGG et al. 2003).

QHA Results

This stream was not evaluated.

Sand Canyon

Sand Canyon Creek originates in dryland crop and rangeland areas, drains 3,130 acres (4.8 sq. mi.), and flows through the town of East Wenatchee before joining the Columbia River just downstream of the Wenatchee River confluence (Bartu and Andonaegui 2001). Although this stream was not evaluated and is not suitable for anadromous fish use, a small portion of the stream is accesssibe and is used by some anadromous fish. The stream is comprised of three reaches. In the first reach, juvenile summer steelhead and spring and summer/fall Chinook rear up to an impassable culvert/irrigation diversion at State Highway 28 (RM 0.4)(Bob Steele, pers. comm., 2001). Juvenile Chinook and steelhead/rainbow trout were observed from the mouth upstream to RM 0.25 in the early-mid 1990s. There were more juvenile Chinook than steelhead/rainbow that had strayed into Sand Canyon Creek from the Columbia River. It is uncertain, whether fish can currently reach the barrier because of a thicket of golden willow growing horizontally across the stream and a headcut in this lower reach that may be impassable to fish (Bartu and Andonaegui 2001).

The second reach is about 1 mile long and ends at Eastmont Ave., while the third is 5.8 miles and is dry much of the year except for storm flooding events. Steelhead/rainbow trout juveniles found above the barrier are most likely planted rainbow trout (Bartu and Andonaegui 2001). A 2001-2002 study (PGG et al. 2003) noted that although the stream had sporadic observations of anadromous salmonid use from the late 1970s to the early 1990s, here was no evidence of current anadromous fish use.

Juvenile coho have also been found in Sand Canyon Creek and are assumed to be hatchery plants naturalized from the Turtle Rock fish hatchery. Coho have been extirpated from the upper Columbia system since the turn of the century. It is assumed that beavers were historically active in Sand Canyon (Bartu and Adnonaegui 2001).

Riparian Condition

Riparian vegetation is thick at the confluence of Sand Canyon Creek , dominated by cottonwood (*Poplulus trichocarpa*), willow (*Salix spp*.), red osier dogwood (*Cornus stolonifera*), hawthorne (*Crataegus douglasii*), wild rose (*Rosa spp*.), snowberry (*Symphoricarpus albus*), and reed canary grass(*Phalaris arundinacea*) (Washington State Noxious Weed Control Board 1997). The lower 1.5 miles of the stream are bordered by a mixture of residential properties, orchards, and a county park. Riparian vegetation throughout this section consists of an almost continuous but narrow band of small to medium deciduous trees, mixed with areas of shrubs. Upstream of the developed areas and agricultural lands where the channel transitions into the V-shaped valley segment, the channel is bordered by a sparse stand of low shrubs for approximately half a mile. The steep hillsides bordering the headwater areas and tributaries support sagebrush, and streamside trees or shrubs are largely absent (Pacific Groundwater Group and Montgomery Water Group 2003). No aquatic exotic species have been noted, but diffuse knapweed and baby's breath have been observed in the lower reach of Sand Canyon (Washington State Noxious Weed Control Board 1997).

Channel Condition and Diversity

From the base of Badger Mountain foothills to RM 2.0, Sand Canyon Creek is naturally confined in a deep canyon with very little potential for overbank flows (KCM 1995). The stream corridor from RM 2.0 to RM 0.0 has been impacted by development in the East Wenatchee area; in some areas only an orchard or pavement provide the drainage way with no defined channel. The lower reach (RM 0.0 - 0.25) has been channelized, intentionally moved with machinery and placed in its present channel (Bartu and Andonaegui 2001).

The Comprehensive Flood Hazard Management Plan of 1995 addresses flooding in Sand Canyon and its impact on an urban area. Flooding is typically caused by two types of storm events: summer thunderstorms and late winter-early spring rainstorms combined with snowmelt. Although both types of storms can cause extensive flooding, summer thunderstorms have resulted in the most damaging floods to the City of East Wenatchee (KCM 1995). The upper portion of Sand Canyon consists primarily of wheat lands that lie fallow between crop rotations. Minimal vegetative cover during the fallow period results in soils being particularly susceptible to erosion. The canyon descends from the uplands to the terraces where urban areas and orchard lands are located. Sand Canyon also contains active and potential slide zones caused by oversteepened and undercut slopes. Because of the scarcity of drainage facilities below these canyons, floodwaters travel in streets and natural drainage depressions between the streets. Existing drainage culverts and pipe systems are rapidly filled and plugged with sediments during these runoff events, rendering them nonfunctional. The floodwaters, traveling toward the Columbia River, cause extensive erosion damage and fill the existing drainage systems with sediment (KCM 1995).

Fine Sediments

The Sand Canyon Creek Basin is composed of an old massive slump containing abundant, highly erosive fines, silts, and aeolian sands. Hardly any bedrock is exposed in the drainage; therefore little cobble and gravel is present. As a result, the stream exhibits heavy channel loading of fine sediments. The stream does not have the transport capacity to clear the small material from the streambed. The sediment deposition in Sand Canyon Creek is overwhelming the capacity of the stream to transport fines downstream (PGG et al. 2003).

Floods within Sand Canyon Creek are compounded by extreme soil erosion and sedimentation from the sandy soils and lack of cobble in the stream, particularly on steep and barren, or lightly vegetated, slopes. In undeveloped areas, erosion problems are relatively rare because rain infiltrates the highly permeable soils reducing the amount of surface water runoff. Most undeveloped areas also have natural vegetative cover, which helps strengthen the soil surface to reduce the transportation of sediment. However, in developed areas with streets and other impermeable surfaces, large volumes of runoff may rapidly erode the barren soils along the road margins (few roads within East Wenatchee have curbs and gutters). In addition to erosion problems in developed areas, a large amount of runoff and sediment is transported from bare soils in the agricultural areas immediately above East Wenatchee (KCM 1995).

Water Quantity and Quality

Sand Canyon Creek is naturally a seasonal stream that carries spring runoff, generally going dry by early-to-mid-summer except for when instream flows are generated by heavy summer storm events. Irrigation, agriculture, and lawns have increased the baseflow, and currently instream flows are maintained through the irrigation season by irrigation return flows directly to the stream at RM 0.50 from the Wenatchee Reclamation District Irrigation Canal, between late March and October (Bartu and Andonaegui 2001). From May-September 2001, flows ranged between approximately 0.5 and 3.0 cfs, with the lowest flows occurring during the month of August (PGG et al. 2003).

Irrigation return flows from the Wenatchee River maintain a colder consistent temperature compared to natural stream temperature, attracting rearing salmonids from the Columbia River and providing rearing habitat in a tributary that normally would be dry. The loss of irrigation return flows into Sand Canyon Creek would eliminate summer flows and would have a detrimental effect on salmonids. Baseflows in the winter are likely to be a result of the irrigation water infiltration in the lower part of this watershed throughout the growing season. No pools over a foot in depth have been observed to date (Bartu and Andonaegui 2001).

Temperatures in Sand Canyon Creek are too warm for summer rearing fish production. Maximum water temperatures in the stream were very high and exceeded 18ºC almost continuously between mid-June and mid-September, 2001. They exceeded sublethal water temperatures for salmonid fishes and peaked above 24ºC (PGG et al. 2003).

All pH levels monitored during the summer of 2001 were within the Class A water quality criterion between 6.5 and 8.5 pH units (+/- 0.5 pH units). The waters are generally alkaline in nature, which is typical of arid and semi-arid conditions. Sand Canyon Creek water reflected irrigation withdrawals from the Wenatchee River system. The stream was neutral in pH, was low in mineralization (60 to 150 µmhos/cm), and supported relatively soft waters compared to other local streams (PGG et al. 2003). Dissolved oxygen (DO) concentrations in Sand Canyon complied with the state standard throughout the 2001 and 2002 sampling period (PGG et al. 2003).

Sand Canyon Creek contains a low density and diversity of macroinvertebrates and fauna is comprised entirely of short-lived taxa. The majority of the taxa exhibit burrowing habits that allow them to survive in temporary habitats when streamflows cease (PGG et al. 2003).

QHA Results

This stream was not evaluated

Quilomene Creek

The Quilomene Creek Watershed, located in Kittitas County, contains about 14,600 acres. The stream is approximately 10 miles long with one primary tributary, Brushy Creek. Of special note, in some documents Quilomene is considered a tributary to Brushy Creek and others the reverse. Ninety-nine percent of the Quilomene Creek Watershed is located on public land (WDFW Colockum Wildlife Area).

Historically, it is presumed that anadromy extended into the headwaters (Viola, pers. comm., 2004). However, salmon were likely present only in the lowest reach. Steelhead/rainbow trout would have been distributed throughout the watershed where habitat was accessible. In 1999 Grant County Public Utility District (GCPUD) surveyed the lowest reach and found several species of fish present; rainbow trout, Chinook salmon, speckled dace, and bridgelip sucker. Other data indicate that steelhead have used the bottom four tenths of a mile for migration (Streamnet 2003).

For use in the QHA model, Quilomene Creek was broken into two reaches. Reach 1 begins at the mouth and extends up-stream to RM1. Reach 2 extends from RM1 to the headwaters.

Riparian Conditions

The riparian zone adjacent to in Reaches 1 is dense with thick brushy vegetation common to the area. WDFW speculates that the riparian zone on the remainder of the stream is also covered with brushy vegetation, however, only the lower 1-mile of the stream was sampled because of its remoteness.

Channel Condition and Diversity

Channel characteristics in Reach 1 remain very similar to historic conditions, but may have been degraded by the excessive cattle grazing that took place in the 1900s (Paschal J. WDFW pers.

com. 2003). An earthen dam was constructed in 1964 located about half way up the length of the stream (Streamnet 2003). More surveys are needed.

Fine Sediments

Reach 1 was dry when WDFW made a site visit in July of 2003. This condition precluded a reliable estimate of substrate characteristics. WDFW speculates that the stream presently holds considerably more fine sediments than what occurred prior to the extensive cattle grazing of earlier years. More surveys are needed.

Water Quantity and Quality

Very little is known about year–round water flows or the water quality in Quilomene Creek. However, at times, water is absent in the lower reach. The channel in Reach 1 was found to be dry in July of 2003 on a site visit by WDFW staff. Lack of year-round water flow under normative conditions is not ideal for fish use.

QHA Results

Both Chinook and rainbow trout were used in the assessment model for Reach one (Table 31). Reach two was not analyzed because no existing data or field survey information was available, although rainbow trout may inhabit the reach. The restoration ratings for Reach one for both species of fish was about one third of the protection rating. The ratings for Chinook in reach one were identical to the rainbow trout model. Of note, the sediment and high temperature were the two lowest ranked attributes of all of the ratings.

Table 31 QHA habitat scores for Quilomene Creek, WA.

Reach	Species	Protection Score	Restoration Score
Quilomene 1	Chinook	168	60
Quilomene 1	Rainbow/steelhead	168	60

Rock Island Creek

The Rock Island Watershed contains approximately 54,822 acres. Over 85% of the stream runs through private lands. The stream has two primary tributaries: Bevington Canyon and Beaver Creek. Flows in Rock Island Creek are dependent on spring snowmelt runoff and spring groundwater recharge. A spring at RM 0.75 maintains perennial flow from RM 0.75 to the mouth (Bartu and Andonaegui 2001).

Rock Island Creek was broken into three reaches: the first is the flowing portion that is accessible to anadromous fish, the second is a long dry reach with no substantial riparian vegetation (a natural condition), and the third is the entire upper part of the watershed where water flows intermittently in most places, but has significant existing riparian vegetation. Recent surveys indicated that the lowest reach of this stream has Chinook and steelhead use (unpublished data, R2 Consultants, July 2003; Meyers et al. 1998).

Riparian conditions

Currently there are groves of quaking aspen and cottonwoods at the mouth of Rock Island Creek. In 1887 when the Keane family settled at the mouth of Rock Island Creek, it was alive with groves of quaking aspens and cottonwoods. Today's stand is probably a remnant of what once was present. In the upper reaches, riparian habitat is in fair to poor condition.

Channel Condition and Diversity

The stream reach inventory/channel stability evaluation conducted in 2002 indicates a fair rating (79 points) (PGG et al. 2003).

Fine Sediments

Rock Island Creek was assessed by R2 Consultants, for Foster Creek Conservation District and found the lowest reach had fines <6mm of 16% in 2002 (PGG et al. 2003). High levels of fine sediment accumulations were not observed in the channel, likely because of the spring-fed character of the stream. Spawning and rearing habitat and food production should not be compromised as a result of fine sediment levels noted in Rock Island Creek. The present frequency of pools in Rock Island Creek is consistent with pool-riffle channels under low LWD levels that occur in the creek (Montgomery and Buffington 1993)

Water Quantity and Quality

There are no peak stream flow records for Rock Island Creek except for an observation made by Lucy Keane in 1999 and 2000. "In 1999 Rock Island Creek stopped running full length the third week in May until the next spring. There was water intermittently 2-3 miles above the spring. It was dry in-between these places. In the year 2000, the creek started running March 24th full length and stopped March 31. It ran again full length April 2nd to the April 18th but [was] extremely muddy. There has been no water since then in that section" (Keane 2000).

QHA Results

Recent surveys presented during the analysis meetings have indicated that the lowest reach of this stream has Chinook, coho, and steelhead use (Table 32). The second reach was assessed, but since it is usually dry no resulting protection or restoration ratings were calculated. The third reach was assessed for rainbow trout only. For both the lowest and highest reaches the ratings were nearly the same for protection and restoration. The protection ratings for both reaches were higher than the restoration ratings. The ratings for Chinook in reach one were identical to the rainbow trout model.

Table 32 QHA habitat scores for Rock Island Creek, WA.

Reach	Species	Protection Score	Restoration Score
Rock Island 1	Chinook	165	63
Rock Island 1	Rainbow/steelhead	165	63
Rock Island 3	Rainbow/steelhead	174	54

Sand Hollow Creek

The Sand Hollow Creek Watershed, located in Grant County, contains approximately 35,518 acres and is approximately 10.43 miles in length. The stream has no identified tributaries and receives a significant amount of flow from irrigation return(s). Other data indicate that steelhead have used the bottom two miles for migration and spawning and rearing of fall Chinook and summer steelhead (Streamnet 2003). In 1999 GCPUD surveyed the lowest reach and found several species of fish present: rainbow trout, longnose suckers, cottids, largescale suckers, and bridgelip suckers. Only one reach was established for use in the QHA model - from the mouth to RM 10.43/the top of the wasteway.

QHA Results

Both Chinook and rainbow trout were used in the assessment model (Table 33). The rating for restoration was zero because flows are artificially maintained and the reference conditions were set to zero. The protection rating was the same for both species. The habitat conditions were rated moderate to poor because of the large area in agricultural use and irrigation return flow (water quality concerns). Actual conditions need to be investigated and verified.

Table 33 QHA habitat scores for Sand Hollow Creek, WA.

Reach	Species	Protection Score	Restoration Score
Sand Hollow 1	Chinook	162	No scores
Sand Hollow 1	Rainbow/steelhead	162	No scores

Skookumchuck Creek

The Skookumchuck Creek Watershed, located in Kittitas County, contains approximately 12,763 acres. Thirty percent of this stream is publicly owned. The stream has one primary tributary, the North Fork. In 1999, GCPUD surveyed the lowest reach and found only rainbow trout to be present. Two reaches were identified for use in the QHA Model: the mouth to RM 0.75, and RM 0.75 to the headwaters.

Both Chinook and rainbow trout were used in the assessment model (Table 34), although the assessment was only done for reach one; reach two has no information available to date. This stream had the highest protection rating in the Subbasin, and had a low restoration rating. None of the parameters raised “red flags”, but fine sediment had a less than normative rating.

Table 34 QHA habitat scores for Skookumchuck Creek, WA.

Reach	Species	Protection Score	Restoration Score
Skookumchuck 1	Chinook	213	15
Skookumchuck 1	Rainbow/steelhead	213	15

Squilchuck Creek

The headwaters of Squilchuck Creek lie in the upper reaches of Beehive Mountain, Mission Peak, the Naneum Ridge, and Wenatchee Mountain. Squilchuck Creek flows 10.6 miles (USFS 1998) in a northeast direction to its confluence with the Columbia River (RM 464.0), four miles downstream of the Wenatchee River confluence. Elevation ranges from 6,800 feet along the southwest divide near Mission Peak to 653 feet at the mouth. There are approximately 18,167 acres (28.4 square miles) in the watershed, 73% of the watershed is privately owned, with the first 9.0 miles of stream flowing through private and some state land (USFS 1998). The upper 1.6 miles of Squilchuck Creek flow through USFS managed land. County Road 711 parallels the stream channel, crossing it twice. Mission Ridge Ski Area lies at the end of this road.

Topography of the watershed is highly variable with sizeable areas of gentle topography, very steep slopes, numerous natural depressions, and vertical rock cliffs. Geologic processes included extensive erosion of underlying sediments and landslides and earth flows that resulted in talus slopes of the Rubbleland-Rock Outcrop type (USFS 1998). Rubbleland-Rock formations have almost total infiltration so that rain and snowmelt water passes immediately into the fractured basalt and moves through the watershed as subsurface flow. Soils are also extremely permeable, formed when earth flows mixed angular basalt rock with underlying, weathered sandstone formations. Therefore, springs are numerous, but usually surface and then disappear subsurface without developing significant wetlands.

Access to habitat for salmon and steelhead / rainbow trout is very limited because of the low precipitation, reliance on snow accumulation and snowmelt to support instream flows, and high permeability of the soils and geology. This condition is worsened during low water years. Surface water diversions contribute to dewatering and low flows in Squilchuck. Chinook salmon use is naturally limited to the lower reaches of Squilchuck Creek before steep channel gradient precludes upstream fish passage. Adult steelhead trout, being stronger swimmers and entering the drainage during spring runoff, could naturally penetrate higher into the watershed on good water years, given passage at culverts and diversion dams. However, intermittent flows later in the year, coupled with severe habitat degradation present significant limitations to steelhead/rainbow productivity in this watershed (WRIA 45 Report).

For use in the QHA Model, Squilchuck Creek was divided into three reaches; Reach 1 extends 0.5 mile from the mouth upstream to the South Wenatchee Avenue culvert. Reach one and two were split because this culvert is a barrier to fish migration. Reach 2 starts at that culvert and extends 6.0 miles upstream to Squilchuck State Park. Reach 3 begins at the park and extends upstream 2.0 miles to ½ mile west of Mission Ridge Sky Area.

Riparian Vegetation

Riparian vegetation on Squilchuck Creek is generally dense and brushy but occurs in patches because of development (trailer parks, roads, and railroads), and rural/residential and pastureland conversion. Tree cover has been significantly reduced in the upper portion of the drainage from natural conditions (USFS 1998). The once forested area of Squilchuck Creek is now ski runs, chair lifts, and maintenance roads (USFS 1998).

Channel Condition and Diversity

The lower watershed (below Squilchuck State Park at RM 6.0) is dominated by seasonal channels that flow during spring snowmelt runoff or during high intensity summer thundershowers. Perennial streams are limited to the upper Squilchuck area and include Miners Run, Lake Creek, and upper Squilchuck Creek above the Mission Ridge Ski Area chair 2 ski lift. Portions of Squilchuck Creek that flow under the chair 2 ski lift area go subsurface where it flows through rubble rock (USFS 1998). These streams are steep gradient (>10%), boulder and cobble-dominated, stable channel types (Rosgen A and B type channels) confined by narrow canyons (USFS 1998). The USFS surveyed the stream channels and draws on federally managed land in the watershed. Stream channel migration potential is limited by development and land conversion.

Fish passage barriers also exist in Squilchuck Creek: the Burlington Northern yard culvert at RM 0.1 is a partial barrier to fish passage (Heiner, pers. comm., 2001), then the S. Wenatchee Avenue County Road culvert at RM 0.3 is a full barrier to fish passage (Steele, Pers. comm., 2001). Additional barriers have been identified upstream of RM 0.3 (Harza/Bioanalysts 2000).

Water Quantity and Quality

Water quantity in Squilchuck Creek is limited both naturally and by irrigation water withdrawals. Under natural conditions, channels in the lower portion of the Squilchuck watershed are dominated by naturally intermittent drainages that only flow during spring runoff or during high intensity summer thundershowers (USFS 1998).

About 65% of the total annual water production occurs as snowmelt stream flow in April through July. Annually, there is an excess of available surface water during melt seasons (USFS 1998) but inadequate supplies during the remaining portion of the year. This seasonal distribution of water supply has resulted in construction of water storage facilities by agricultural users. Water storage, reservoir management, and water diversions have affected the natural flow regime of Squilchuck Creek (Steele, pers. comm., 2001). Release of irrigation water from the Beehive Reservoir augments stream flow between the reservoir outfall and points of diversion for individual water right holders. The effects of the diversions and return flows on instream habitat conditions are undetermined at this time.

Water quality in Squilchuck Creek is unknown, but is likely compromised by chemical runoff from agricultural practices. On July 14, 2003 at 1:00 P.M during a site visit to the stream mouth WDFW recorded water temperature and dissolved oxygen (DO) measurements of 62^0F and 8.0 ppm, respectively (Viola, pers. comm., 2003). That same day, water temperature, DO and creek mouth water flows were well within tolerance limits for both juvenile steelhead and Chinook. Currently no information is available concerning year-round daily water temperatures or DO levels.

Fine Sediments

On July 14, 2003 WDFW briefly sampled substrates in all three reaches of Squilchuck Creek. We found heavy to moderate siltation in Reaches 1 and 2 and minor siltation in Reach 3. Currently we are unsure of historical substrate conditions but speculate that silt loads in the stream were less than currently exists. The current accumulation of silt is likely a result of agricultural practices, possible historic cattle grazing and minor silt contributions form the ski area. However chair lifts and ski runs are completely vegetated with either introduced or native species and, in many cases, have a cover of young tree seedlings. Very little exposed mineral soil exists and that which does will revegetate rapidly. Current use of the ski area has insignificant potential effects on sediment transport or changes in basic hydrology (USFS 1998).

QHA Results

Reaches one and two were modeled for both rainbow trout and Chinook salmon and reach three for rainbow trout only (Table 35), as there is no documentation of Chinook occurring that far up in the watershed. Historically Chinook used reach two, but to what upper extent is unknown. The analysis and rating for reach1 are the same for both species and they have nearly equal protection and restoration scores compared to the upper two reaches. Protection ratings increase with each reach going up the watershed. Restoration ratings decrease by each succeeding reach for the rainbow trout model. The Chinook model shows no protection rating for Reach two because of the lack of access (i.e., current conditions without fish end up having a zero value in the model). Reach 1 had low habitat ratings and all three reaches were rated poorly for obstructions as evident in the Limiting Factors Analysis (Andonaegui 2001).

Table 35 QHA habitat scores for Squilchuck Creek, WA.

Reach	Species	Protection Score	Restoration Score
Squilchuck 1	Chinook	123	96
Squilchuck 1	Rainbow/steelhead	123	96
Squilchuck 2	Rainbow/steelhead	162	57
Squilchuck 3	Rainbow/steelhead	207	15

Stemilt Creek

The Stemilt watershed is approximately 40 square miles in size with the headwaters of Stemilt Creek originating in the upper reaches of Naneum Ridge and Wenatchee Mountain. Stemilt Creek flows in a northeasterly direction from its headwaters for approximately 12.35 miles (Williams et al. 1975) before entering the Columbia River (RM 461.9) six and one half miles downstream of the Wenatchee River confluence (RM 468.4). Elevation ranges from 6,600 along Naneum Ridge to 650 feet at the mouth. The public owns 58% of the land in the watershed. The lowest 5 miles of stream flows through private land. Stemilt Creek County Road parallels the stream channel for the first 6 miles.

Habitat for Chinook and rainbow/steelhead in the Stemilt Creek Watershed is limited. Chinook and rainbow/steelhead juveniles are known to occur in the lower Stemilt Creek Watershed and rainbow trout and brook trout are distributed throughout the watershed where low flows and natural and human-made fish passage barriers do not preclude access to habitat. Surface water diversions contribute to dewatering and low flows in the lower 3 to 6 miles of Stemilt Creek.

For use in the QHA model, Stemilt Creek was divided into three reaches: the mouth to the first large pump (RM 0.1), the pump to the end of water diversions, and from that point to the headwaters. Reach one and two were split because of an existing road crossing. Reach two and three were spilt because of a change in gradient; Reach 3 has a higher gradient than Reach 1 and 2. Reaches 1 and 2 are privately owned.

Riparian Condition

On July 14 2003 WDFW documented various habitat conditions within the Stemilt Creek watershed including riparian condition. They reported very dense brushy vegetation common to the area in the riparian zones on both sides of all three reaches of Stemilt Creek. The only disturbance to these excellent conditions appears to be at a few road crossings at irrigation pumping sites. However, this disturbance is minimal and does not represent a significant factor that would limit fish production.

Channel Condition and Diversity

Currently channel condition and it’s potential for natural movement and habitat diversity is restricted in Reaches 1 and 2 because of the presence of a road that runs adjacent to the creek, a few road crossings, and an undetermined number of irrigation diversion structures. Reach 3 appears to be only slightly altered compared to assumed historical conditions. However, there are an unknown number of water diversion structures on this reach that affect channel condition.

Only one source of published information describing habitat conditions or land use affects on aquatic habitat in the Stemilt Creek watershed was found, the draft Chelan County Fish Barrier Inventory Database (Harza/Bioanalysts 2000). The Harza survey identified the first fish passage barrier culvert on Stemilt Creek at RM 1.6 on a private road crossing.

Fine Sediments

WDFW briefly sampled substrates (July 14, 2003) in all three reaches of Stemilt Creek and found heavy to moderate siltation in Reaches 1 and 2 and minor siltation in Reach 3. Historical silt loads are unknown, but were probably less than currently exists. The present accumulation of silt is likely a result of agricultural practices and possibly, historic cattle grazing.

Water Quantity and Quality

July 14,2003 study results, indicated water quantity and quality parameters in Reaches 1 and 3 were capable of supporting juvenile steelhead and salmon, but Reach two was almost devoid of water. Water temperature was 64^{o} F (July 14, 2003, 11:30 A.M.) and 59^{0}F and DO was 8.0ppm and 9.0pmm (3:30P.M.) in Reaches 1 and 3 respectively. Water flows were estimated to be about 75% of bank full in Reach 1 and 50% in Reach 3. Reach 2 was being dewatered for irrigation purposes. The only water left was stagnating in a few beaver ponds. It is unlikely that juvenile Chinook or rainbow/steelhead would have survived long under these conditions. Year-round water quality is unknown; WDFW suspects that the pesticides used in the prolific orchards in this watershed have the potential to contaminate Stemilt Creek.

Regarding water quantity and use in the watershed, Hammond, Collier, Wade, & Livingstone Associates of Wenatchee, Washington, is currently developing a Comprehensive Water Conservation Plan for the Stemilt Irrigation District. The plan is to analyze the District's irrigation distribution system and propose measures to conserve irrigation water within the District's facilities. The report was due out in late 2001.

There are four irrigation districts (Wenatchee Heights, Stemilt, Lower Stemilt, and Kennedy-Lockwood) and numerous private diversions operating in the Stemilt watershed. Information on location and actual water use of surface waters in the watershed is not available at this time. The Stemilt watershed was adjudicated in 1926 with no provisions for maintaining instream flows. As a result, certified water rights exceed available surface flow and reduce the lower two to three miles of Stemilt Creek to a trickle during the irrigation season each year. The amount of available moisture resulting from snowmelt and precipitation affects low flows; the drier the year, the earlier Stemilt Creek will be reduced to a trickle (Viola, pers. comm., 2003, Riegert, pers. comm., 2001). Each year, water use by junior water right holders' is curtailed as instream flows decrease and some senior water right holders' may also lose water privileges as flows continue to decline (Riegert, pers. comm., 2001).

Intermittent flows in the upper reaches of Stemilt Creek and its tributaries likely occurs naturally, given the hydrology and geology as it affects the interaction between ground and surface waters. It is possible that dewatering in lower Stemilt may also have occurred naturally on some, if not all years prior to Euro-American influence. The hydrology of the Stemilt watershed is not well known.

QHA Results

Only Reach one was modeled for Chinook (Table 36); it is believed that few Chinook adults would venture into and spawn in Reach two because of water depth. Reaches one, two, and three were modeled for rainbow/steelhead. Historically Chinook may have used Reach two, but to what upper extent is unknown. The model resulted in much higher scores for protection compared to restoration scores.

It is correct that most of this tributary is in need of some protection. However, the habitat conditions that limit fish production the most are the extensive irrigation water withdrawal that reduces the flow in Reach two of Stemilt Creek to a trickle each year and the presence of an unknown number of barriers to fish migration throughout the drainage.

Table 36 QHA habitat scores for Steimilt Creek, WA.

Reach	Species	Protection Score	Restoration Score
Stemilt 1	Chinook	162	57
Stemilt 1	Rainbow/steelhead	162	57
Stemilt 2	Rainbow/steelhead	147	75
Stemilt 3	Rainbow/steelhead	195	27

Tarpiscan Creek

The Tarpiscan Creek Watershed, located in Kittitas County, contains approximately 15,492 acres and is about 6.23 miles in length (north fork). The stream has two primary tributaries, the South and North Forks. Eighty-eight percent of the land adjacent to the stream is in the publicly owned WDFW Colockum Wildlife Area.

Historically, it is presumed that anadromy extended into the headwaters (Viola, pers. comm., 2004). However, salmon were likely present only in the lowest reach. Steelhead/rainbow trout would have been distributed throughout the watershed where habitat was accessible. Other data indicate that steelhead have used the bottom tenth of a mile for rearing and migration and the next upstream 0.7 miles for spawning and rearing (Streamnet 2003). In 1999 Grant County Public Utility District (GCPUD) surveyed the lowest reach and found several species of fish present; rainbow trout, Chinook salmon, longnose dace, brown trout, and bridgelip sucker.

For use in the QHA model, Tarpiscan Creek was divided into three reaches: the mouth to the confluence of the north and south forks (RM 0.51), and the north and south forks, 5.72 and 5.05 miles respectively.

Riparian Condition

The riparian zone adjacent to Reaches 1and 2 are covered with thick brushy vegetation common to the area. Reach 3, was not sampled because of its remoteness, but WDFW staff speculate that the riparian zone on this reach is also covered with brushy vegetation.

Channel Condition and Diversity

Channel characteristics in both Reach 1 and 2 remain very similar to historic conditions, but may have been degraded by excessive cattle grazing that took place in the early-mid 1900s. No passage barriers were found in Reaches 1 and 2. No survey of Reach 3 was completed, but more surveys are needed.

Fine Sediments

Both Reach 1 and 2 were dry when WDFW made a site visit in July of 2003. This condition precluded a reliable estimate of substrate characteristics, however, the dry streambed was sampled. The results lead us to speculate that the stream presently holds considerably more fine sediments than what occurred prior to the extensive cattle grazing of earlier years. More surveys are needed.

Water Quantity and Quality

Very little is known about water flows or the water quality in Tarpiscan Creek. However, we do known that at times water is absent in the lower two reaches. The channel in Reach 1 and 2 were found to be dry in July of 2003 on a site visit by WDFW staff. The absence of year-round water flow under normative conditions is not ideal for fish use.

QHA Results

Reach one was modeled for both rainbow trout and Chinook salmon and Reach two, the north fork, for rainbow trout only (Table 37), as there is no documentation of Chinook occurring that far up in the watershed. In the Chinook model, the spawning and rearing section of the hypothesis was not included in the analysis and resulted in the rating for protection and restoration being lower than that of rainbow trout. The analyses depict a substantially higher protection rating compared to the restoration rating.

Table 37 QHA habitat scores for Tarpiscan Creek, WA.

Reach	Species	Protection Score	Restoration Score
Tarpiscan 1	Spring Chinook	159	12
Tarpiscan 1	Rainbow/steelhead	192	15
Tarpiscan 2	Rainbow/steelhead	N/A	N/A

Tekison Creek

The Tekison Creek Watershed, located in Kittitas County, contains roughly 21,138 acres. The stream is about 7.7 miles in length and has one primary tributary, Stray Gulch. Ninety-five percent of the land adjacent to the stream is in the publicly owned WDFW Colockum Wildlife Area and is currently protected from habitat degradation. Steelhead have used the bottom tenth of a mile for migration and the adjoining 1.3 miles upstream for rearing, migration, and spawning (Streamnet 2003; Viola, pers. comm., 2003).

Tekison Creek was divided into two reaches for the QHA analysis. Reach 1 was established from the mouth to a large gradient change (RM 1.27), and Reach 2 extended up-stream from there to approximately RM 9.18.

Riparian Condition

Both banks of Reach 1 are covered with brushy vegetation common to the area. WDFW speculates that the riparian zone on the remainder of the stream (Reach 2) is also covered with brushy vegetation, but Reach 2 was not sampled because of its remoteness.

Channel Condition and Diversity

We speculate that channel characteristics in both Reach 1 and 2 remain very similar to historic conditions, but may have been degraded by excessive cattle grazing that took place in the 1900s. No passage barriers were found in Reach 1. No survey of Reach 2 was completed, but more surveys are needed.

Fine Sediments

Reach 1 of Tekison Creek was dry when WDFW made a site visit in July of 2003. This condition precluded a reliable estimate of substrate characteristics. However, WDFW did attempt to sample the dry streambed. What we found leads us to speculate that the stream presently holds considerably more fine sediments than what occurred prior to the extensive cattle grazing of earlier years. More surveys are needed.

Water Quantity and Quality

Very little is known about year–round water flows or the water quality in Tekison Creek. However, we do known that at times water is absent in the lowest reach. The channel in the lower reach was found to be dry in July of 2003 on a site visit by WDFW staff and GCPUD also noted it as being dry in previous years (Duvall, pers. comm., 2003). Water flow under normative conditions is not ideal for fish use.

QHA Results

Reach one was modeled for both rainbow trout and Chinook salmon and reach two for rainbow trout only (Table 38), as there is no documentation of Chinook occurring that far up in the watershed because of steep gradient and insufficient flow. In the Chinook model, the spawning and rearing section of the hypothesis was not included in the analysis and resulted in the ratings for protection and restoration being lower than that of rainbow trout. The analyses depict a substantially higher protection rating versus the restoration rating.

Table 38 QHA habitat scores for Tekison Creek, WA.

Reach	Species	Protection Score	Restoration Score
Tekison 1	Chinook	144	24
Tekison 1	Rainbow/steelhead	168	36
Tekison 2	Rainbow/steelhead	198	6

Trinidad Creek

The 17.1-mile long Trinidad Creek located in Lynch Coulee in Douglas and Grant counties drains a watershed of approximately 39,982 acres, 88% of the watershed is privately owned. This stream empties into the Columbia River at the Douglas and Grant County line. The first mile of stream contains habitat suitable for rearing for summer steelhead and Chinook (Streamnet 2003). In 1999 Grant County Public Utility District (GCPUD) surveyed the lowest reach and found several species of fish present; rainbow trout/steelhead, Chinook salmon, long nose dace, cottids, three spine stickleback, bluegill, and northern pike minnow.

For the QHA analysis, Trinidad Creek was broken into two reaches; Reach 1 extends from the mouth upstream 1 mile to just after it crosses under the State Highway 28 Bridge. Reach 2 extends from just after the highway crossing, upstream 6.5 miles to the tunnel at the railroad crossing, and both reaches are privately owned. Reach one and two were split because of an existing road crossing and a change in gradient. Reach two has a higher gradient than Reach 1.

Riparian Conditions

Most of the riparian zone adjacent to Trinidad Creek in Reach 1 is covered with brushy vegetation common to the area. A road crossing and work by heavy equipment has slightly reduced the amount and density of the riparian vegetation in a few places within this reach. The riparian zone on both sides of Reach 2 is completely covered with dense healthy vegetation. The historical condition of the riparian zone on Trinidad Creek is unknown. For the QHA model we speculated that the historical riparian conditions were much like they are today.

Channel Condition and Diversity

Presently the stream channel in Reach 1 is artificially confined between gravel and coble berms that have been bulldozed into place close to both banks. In addition the stream in this reach passes under two road-bridge crossings, both of which also limit lateral movement and channel course. The lowest section of Reach 1 contains an extensive fan created from alluvial deposits. As the stream crosses this fan it becomes wide, shallow and braided. We speculate that certain times the alluvial fan is likely a barrier to up stream migration of adult steelhead and Chinook.

The stream channel in Reach 2 is in a well-defined channel that lacks extensive braiding. Any minor channel migration that might occur over time would not encounter any obstacles, but major movements would be confined by the topography that supports Highway 28. Historical stream channel form is unknown. However, WDFW speculates that the current channel is very similar to what was present in the past.

Fine Sediments

Fine sediment has accumulated in both reaches and is likely the result of up stream agricultural practices. The historical substrate condition is unknown. However, WDFW speculates that much of the fine sediments present today were absent prior to the extensive agricultural activity in this watershed.

Water Quantity and Quality

Current and historical year-round daily water flows and water temperatures on Trinidad Creek are unknown. On July 16, 2003, during a site visit by WDFW, the stream channel at the mouth and two miles upstream was bank full. Water temperature and DO two miles up stream was 64^0F and 8.2 ppm (9:30 A.M.) and 64^0F and 8.7ppm (4:00 P.M.), respectively. Daytime air temperature reached 102^0F (Viola, pers. comm., 2003). Water flow, water temperature, and DO were well within tolerance limits for juvenile steelhead and Chinook. Water flow in Trinidad Creek is augmented by irrigation return flows from the Columbia Basin Reclamation Project.

This information has led WDFW to be optimistic concerning year-round water flow, water temperature, and DO levels in Trinidad Creek. The level of pollutants in Trinidad Creek is unknown but we speculate that water quality may be compromised by chemical runoff from agricultural uses.

QHA Results

Reach one and two were modeled for both Chinook salmon and rainbow trout (Table 39). The protection ratings for these reaches are similar for Chinook and steelhead, and both reaches scored much higher for protection compared to restoration. Reach two was scored much lower for restoration for Chinook than for steelhead or for Chinook in Reach one. It is believed that few Chinook adults would venture into and spawn in Reach two because of water depth, but the rearing potential for juvenile Chinook is probably better in Reach two compared to Reach one. Consequently, the QHA restoration rating may be misleading.

The habitat condition that may limit fish production the most in Trinidad Creek is the extensive fan created from alluvial deposition at the mouth of the stream. As the stream crosses this fan it becomes wide, shallow and braided. We speculate that the alluvial fan is likely a barrier to up stream migration of adult Chinook and rainbow/steelhead at times.

Table 39 QHA habitat scores for Trinidad Creek, WA.

Reach	Species	Protection Score	Restoration Score
Trinidad 1	Chinook	177	27
Trinidad 2	Chinook	169.5	4.2
Trinidad 1	Rainbow/steelhead	177	27
Trinidad 2	Rainbow/steelhead	195	15

Whiskey Dick Creek

The Whiskey Dick Creek Watershed, located in Kittitas County, contains approximately 21,971 acres, is about 13.5 miles in length, and 76% of the stream runs through public land. The stream has one primary tributary; the North Fork. In 1999, GCPUD surveyed the lowest reach and found several species of fish present, rainbow trout, threespine stickleback, tench, and northern pike minnow. Summer steelhead have used the bottom 1.4 miles for migration and rearing of summer steelhead (Streamnet 2003).

Two reaches were established on Whiskey Dick Creek for use in the QHA model. Reach 1 extends from the mouth to RM 1.5. Reach 2 extends from RM 1.5 to the headwaters. These reaches were separated at the location (RM 1.5) where the relatively level gradient of Reach 1 begins a sharp climb into the steep gradient of Reach 2.

Riparian Conditions

On August 18, 2003 WDFW surveyed Reach 1 of Whiskey Dick Creek. Both banks were covered with dense riparian vegetation and were assumed to be similar to what occurred historically. However, a dense growth of Purple Loosestrife can be found at the mouth of this stream; this vegetation was likely not present during historic times.

Channel Conditions and Diversity

Channel condition and diversity in Whiskey Dick Creek were in excellent condition and presumably similar to historic conditions. Fine sediments were relatively common in Reach 1 and are presumed to be greater that what occurred historically. This may be a result of the excessive cattle grazing that occurred in the early-mid 1990s.

Water Quantity and Quality

Very little is known about year-round water flows in Whiskey Dick Creek. On August 14, 2003 at 11:20 A.M. a relatively good flow of water was found in the stream. Water temperature was 60^0F and DO was 8 pmm, well within the tolerance limits of Chinook salmon and rainbow/ steelhead.

Both Chinook and rainbow trout were used in the assessment model, but the assessment was only done for Reach one; Reach two has no information available to date (Table 40). Steelhead and Chinook had the same ratings and protection ratings were very high compared to restoration. The stream may also have some flow issues because of natural conditions within the watershed. The water quality appears fairly good, but more information is needed. Sediment was the only other element that is depicted as contributing to a potential limiting factor.

Table 40 QHA habitat scores for WHiskey Dick Creek, WA.

Reach	Species	Protection Score	Restoration Score
Whiskey 1	Chinook	195	15
Whiskey 1	Rainbow/steelhead	195	15

4.2.11 Limiting Factors

Fish and wildlife species in the UMM Subbasin have been affected primarily by agricultural, urban, and rural development, livestock grazing, exotic species, predation, hydropower development and operation, and harvest practices. These activities have lead to habitat degradation, fragmentation, and losses and have negatively impacted the presence, distribution, abundance, and productivity of fish and wildlife.

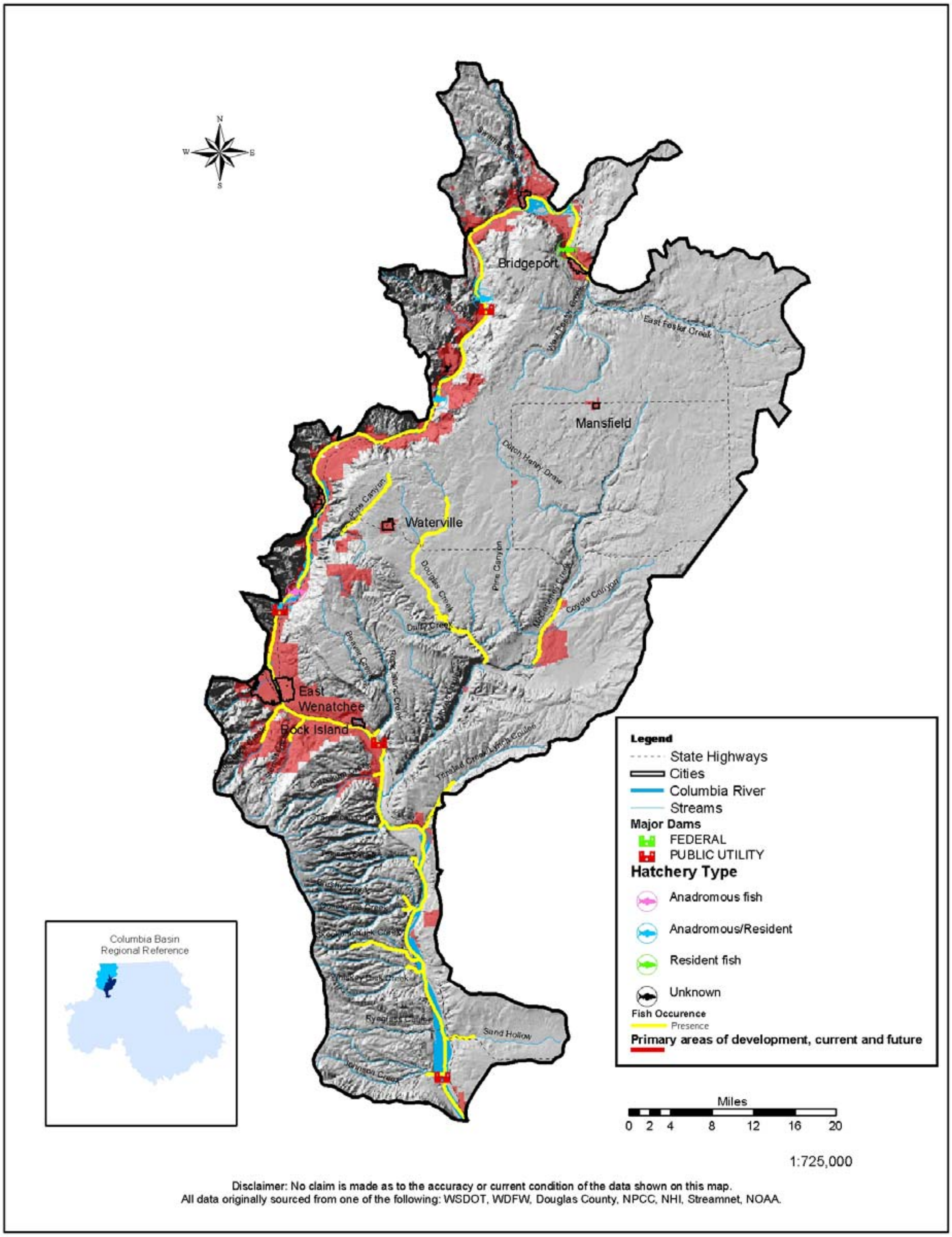
Agricultural Development

Agricultural development in the UMM Subbasin has altered or destroyed approximately one third of the native shrubsteppe habitat and fragmented riparian/floodplain habitat. Agricultural operations have increased sediment loads and introduced pesticides and fertilizers into streams, wetlands, and other waterbodies. Conversion to agriculture has decreased the overall quantity of habitat for many native species, but disproportionate loss of specific communities, such as deep soil shrubsteppe may be particularly critical for certain habitat specialists. The quality of remaining habitat is reduced as fragmentation increases especially for core sensitive species.

Urban and Rural Development

Residential/urban sprawl and rural development have resulted in the loss of large areas of habitat and have increased fragmentation and harassment of wildlife, particularly large areas of habitat that functions as winter refuge for native wildlife. In the UMM most of these areas are at low elevations and are along the Columbia River corridor (Figure 50). In addition, the lower Moses Coulee area serves as winter range for several species, primarily mule deer. As the human population continues to grow, urban and rural residential areas continue to spread into once wild areas and agricultural lands that may have been prime habitat for wildlife. Also, proximity to agriculture or suburban development leads to a high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats). Disturbance by humans in the form of highway traffic, noise and light pollution, and recreational activities (particularly during nesting season and in high-use recreation areas) also have the potential to displace fish and wildlife and force them to use less desirable habitat. For example, the state highways along both sides of the Columbia River from Wenatchee to Brewster have high rates of automobile accidents involving deer.

While urban areas comprise only a small percentage of the land base within the UMM Subbasin (0.5 percent), their habitat impacts are significant. Cities and towns within the Subbasin are largely built along streams and rivers. Channelization and development along streams has eliminated riparian and wetland habitats. Expansion of urban areas creates stormwater drainage, and homes built along streams have affected both water quality and the ability of the floodplain to function normally. Removal of woody, overhanging vegetation along some of the stream corridors may have increased stream temperatures to the point that they are unable to support coldwater biota. In addition, mowing, burning, and tillage of developed uplands removes habitat for upland nesting birds such as red-winged blackbird and gadwall.



(DCTLS 2004)

Figure 50 Primary areas of current and future development in the UMM Subbasin, WA.

Rural development patterns in the UMM Subbasin are also a great concern for fish, wildlife, and their habitats. Several areas have had land subdivided into lots small enough that fragmentation, noxious weeds, continuous disturbance by domestic animals, and similar issues are having negative impacts. Some examples of these are:

Badger Mountain is an island of ponderosa pine habitat within Douglas County, which has been divided into 5 acre lots. Although it is being developed at a rural density, most of the functional use of the habitat is being eliminated for many species. Other similar patterns in the area are likely affecting the species composition of deer. As the open area declines from development patterns, a shift can occur from mule deer use to whitetail deer. The whitetail deer will also eventually disappear as development density increases (Knight 1998, Vogel 1989). This pattern appears to be occurring in the McNeil Canyon area (Jones, personal observation through land owner interviews in 2002), but has not been studied thoroughly.

Rimrock Meadows was originally developed around a now non-functional horse race track in Moses Coulee. Most of the lots are less than one acre, some of which TNC has purchased development rights to. Other recreational lots lie between TNC's owned and managed lands and the WDFW pygmy rabbit habitat area creating fragmentation of the shrubsteppe habitat.

Columbia River shoreline development is occurring in many places and is at high risk of negatively affecting fish and wildlife on both sides of the river from Chief Joseph Dam to Wanapum Dam. Shoreline development in this area is likely to affect migrating birds and water quality, and it separates the shore from the uplands for terrestrial species.

Livestock Grazing

Habitat degradation from livestock overgrazing reduces emergent vegetation and upland vegetation. Livestock grazing in shrubsteppe can result in the reduction of cover that is used by wildlife, such as rodents, sharp-tailed grouse, deer and elk. It can also lead to an increase in shrub density unsuitable for many shrubsteppe obligates. In grazing areas near water sources, the riparian vegetation is often preferred in the dry season, and trampled down for water access. Soils can become compacted, and banks have been eroded. This has resulted in a loss of deciduous tree cover and sub-canopy/shrub habitat for wildlife that use these areas, loss of cover and shade for nearby streams, increases in water temperatures, and increased sedimentation in streams.

Exotic Species

The spread of non-native plant and wildlife species poses a threat to wildlife habitat quality and to fish and wildlife species. Noxious weeds (e.g., cheatgrass, thread-leaved sedge, diffuse knapweed, Dalmatian toadflax, reed canary grass, purple loosestrife, perennial pepperweed, Russian knapweed, Canada thistle, Russian olive, etc.) can threaten the abundance of native wetland and upland plant species utilized by wildlife. For example, Eurasian water milfoil surveys conducted by the CCPUD during the mid 1980s found that milfoil is infiltrating native aquatic plant beds and displacing these native plant species (NPPC 2002). Knapweed and Dalmatian toadflax are two target species of plants that several agricultural programs work to retard along roads and in shrubsteppe areas. Exotic fish and wildlife species (e.g., carp, European starling, walleye, and smallmouth bass) can compete with native fish and wildlife for resources, potentially leading to the decline of the native species. For example, carp within a wetland disturb submergent vegetation and destroy habitat for emergent aquatic insects and thus affect the productivity of the wetland.

Hydropower Development and Operation

The development and operation of the hydropower system has resulted in widespread changes in riparian, riverine, and upland habitats in the UMM. Biological effects related to hydropower development and operations on fish and wildlife and their habitats may be direct or indirect. Direct effects include stream channelization, inundation of habitat and subsequent reduction in some habitat types, and degradation of habitat from water level fluctuations and construction and maintenance of power transmission corridors. Indirect effects include the building of numerous roads and railways, presence of electrical transmissions and lines, the expansion of irrigation and industry, and increased access to and harassment of wildlife.

Several habitat types have been reduced or altered while other habitat types, such as open water and riparian areas, have increased as a result of hydropower. Natural flooding regimes, which affect ecological process in shoreline areas, were altered by the development of hydropower on the Columbia River. Prior to dam construction shoreline habitats were scoured by annual flood events generally producing a habitat of cobble and sand with sparse vegetation; something less than what is traditionally thought of as riparian areas. In general, there has been a decline in the amount of shoreline habitats, but an increase in the amount of riparian habitat due to the stability the upstream storage projects provide in periods of high flows.

Hydroelectric project operations along the Columbia River also directly influence water quality. Water quality parameters affected by hydropower production include total dissolved gas (TDG), water temperature, dissolved oxygen, turbidity, suspended sediments and nutrients. Efforts are underway to reduce hydro impacts on fish and wildlife habitat through various mitigation measures.

Columbia River flows are highly regulated by the hydroelectric complex and seasonal discharge is influenced by water storage at Chief Joseph, Grand Coulee, and Canadian dams and water use practices (Ebel et al. 1989). Dams have created a series of reservoirs and altered the food webs that support juvenile salmonids and other resident fishes, delayed the time when thermal maximums are reached and when cooling begins in late summer (BPA et al. 1994), and lessened the frequency and severity of high flow events that typically modify channels in less controlled circumstances (Stanford et al. 1996). In addition, surface water diversions contribute to dewatering and low flows, and limit access to habitat.

Beak (MCMCP 1995) reported that the productivity in the UMM reservoirs is now limited because of rapid flushing rates, cold temperatures, and lack of shallow water areas. The food that is available in the UMM reservoirs typically provides lower amounts of energy levels than that found in free-flowing areas such as the Hanford Reach (MCMCP 1995). Reduced productivity in the reservoir may affect feeding efficiency of fishes (Rondorf and Gray 1987) but whether or not this acts as a limiting factor in the UMM is not known. Exotic fish species such as carp, have established populations in slackwater areas of the reservoirs. However, whether or not their presence is a limiting factor for salmonids is unknown as well.

All hydroprojects in the UMM currently have operational plans to aid the migration of anadromous salmonids. Juvenile salmonid plans incorporate juvenile bypass facilities as well as spill programs. Adult migration is addressed by the operations of fishways at all hydropower projects below Chief Joseph Dam.

Predation

With the addition of large reservoirs associated with major hydroelectric projects, predator-prey relationships in the UMM have changed. The introduction of non-native predator fish species, increase in populations of indigenous predator fish species, and the immigration of diving piscivorous birds into the UMM are potential limiting factors for juvenile salmonids in the UMM

Smallmouth bass and walleye are not native to the UMM region of the Columbia River. They were introduced into the Columbia River system in the 1940's and 1950's to provide sportfishing opportunities (MCMCP 1995). WDFW stocking records indicate the presence of established populations of bass and sunfish by before 1933 as well. Both species are known to prey upon juvenile salmonids when the opportunity presents itself. Research has shown that smallmouth bass however, are responsible for only a small amount of the predation on juvenile salmonids in Columbia River reservoirs (Rieman et al. 1991). Individual walleye, however, consume as many juvenile salmonids as individual northern pikeminnow (Rieman et al. 1991). Walleye are less abundant than northern pikeminnow, thus their impact on juvenile salmonids is believed to be much less (Beamesderfer and Rieman 1991).

Northern pikeminnow are native to the Columbia River and are abundant and widely distributed. Loch et al. (1994) reported that northern pikeminnow accounted for 75 percent of the total catch of predator fish in the UMM region of the Columbia River in. Their widespread distribution and abundance combined with the knowledge that northern pikeminnow can consume up to 8% of the annual total number of outmigrating juvenile salmonids (Beamesderfer et al. 1996) makes them a predation threat in the UMM to juvenile salmonids.

Caspian terns and double-crested cormorants have been immigrating into the UMM section of the Columbia River in recent years (Todd West, pers. comm., 2001). Nesting periods for these birds is generally during the juvenile salmonid outmigration. Studies conducted in the lower Columbia from April to July on the diet composition of both bird species found that up to 95.3 percent of the double-crested cormorants diet and 99.4 percent of the terns diet by mass consisted of juvenile salmonids (Roby et al. 1997). Data from PIT tag recovery operations at nesting sites found near the UMM showed that nearly 5 percent of the PIT tagged juvenile steelhead and 4 percent of PIT tagged juvenile coho tagged for the Rocky Reach fish bypass evaluations were consumed by avian predators before they reached the ocean in 2001 (unpublished data, Chelan County PUD 2001). PIT tag recovery operations in the lower Columbia River also showed that 15% of the PIT tagged juvenile steelhead that reached the estuary in 1998 were preyed upon by piscivorous waterbirds (Collis et al. 2001). Gulls are also increasing in the UMM and they feed opportunistically on the food source that is available at a given time. During salmonid outmigration in the Lower Columbia, juvenile salmonids were found to comprise 48.9% of gulls diet by mass (Roby et al. 1997). This information indicates that the immigration of piscivorous birds into the UMM may be a limiting factor for juvenile salmonid survival.

Harvest

Where large populations of hatchery fish become the target of heavy fishing pressure and wild races are intermixed, wild fish may be harvested inadvertently at a much greater proportion relative to their total population.

5 Inventory

5.1.1 Introduction, Purpose, and Scope

The intent of the Inventory section is to summarize and assess existing programs, plans, policies, and projects designed to protect and/or restore fish and wildlife habitats and populations within the subbasin. It provides guidance to this document and helps illustrate the extent to which current management strategies are consistent with the subbasin assessment and their adequacy in protecting and restoring fish, wildlife, and ecosystem resources. The activities to date are compared to the assessment to identify the gaps between actions already taken or underway, and actions that are needed to achieve desired results.

Following is a summary of the current management strategies, and restoration and protection projects that are complete or ongoing within the subbasin. The first section contains summarized existing protection programs, such as stream buffers, municipal or county ordinances, conservation designations, or water resource protections. The second section examines existing tribal, federal, state, and local programs, plans, and policies that affect fish, wildlife, and ecosystem resources. The third section is an inventory of past and ongoing restoration and conservation projects (Table 42 - Table 48). Existing Plans and Programs are assessed to determine the extent to which they are consistent with the subbasin assessment and their adequacy in protecting and restoring fish, wildlife, and ecosystem resources.

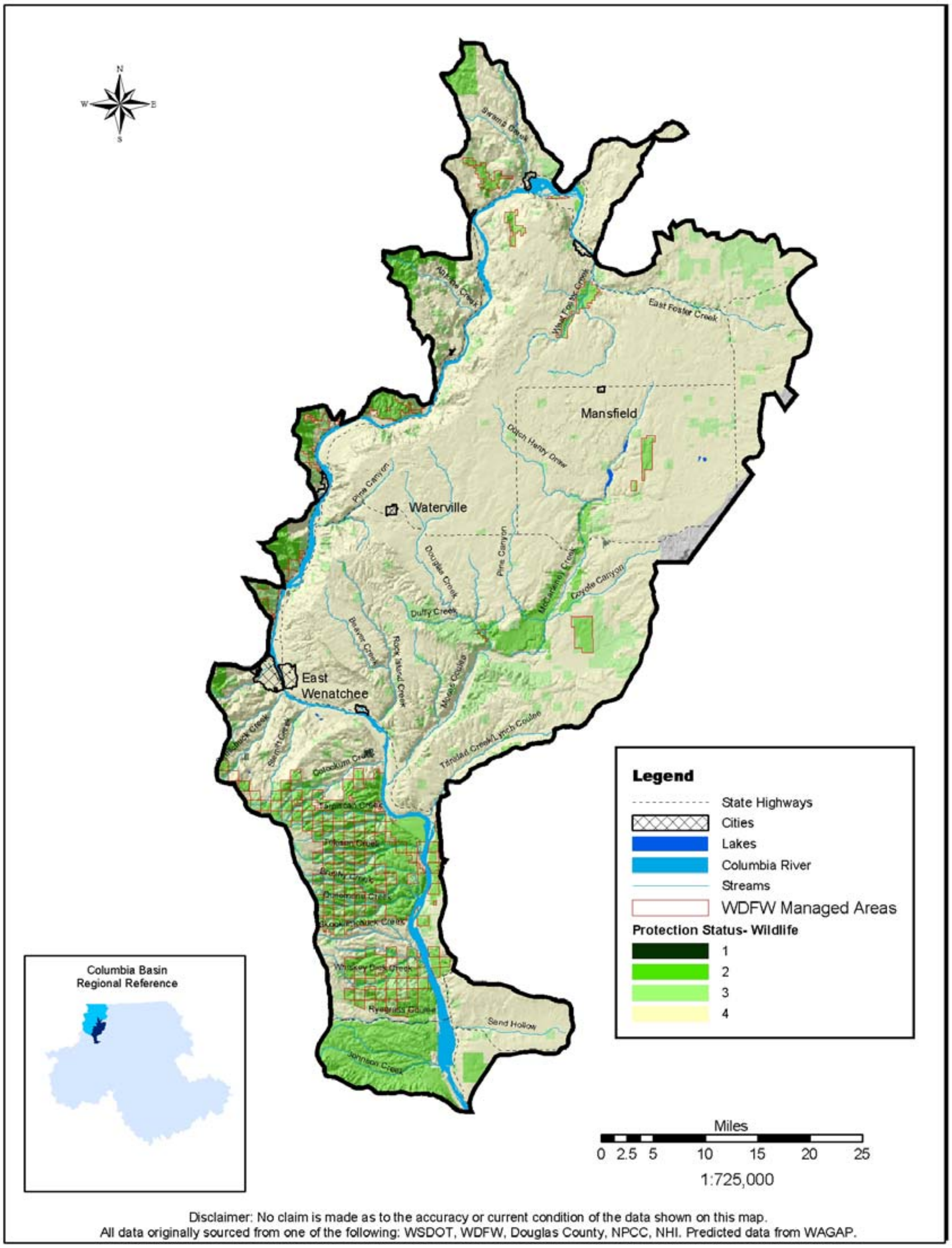
5.1.2 Existing Protection

Wildlife Areas

(This section taken from Ashley and Stovall, unpub. rpt., 2004)

There are almost no lands in the Subbasin that have permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events of natural type are allowed to proceed without interference or are mimicked through management (high protection status – level 1). Approximately 7 % (109,523 acres) of the Subbasin has permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state (medium protection status – level 2) (Figure 51). Approximately 312,766 acres (19 percent) of the Subbasin has permanent protection from conversion of natural land cover for the majority of the area, but is subjected to uses of either a broad, low intensity type or localized intense type (low protection status – level 4). The majority of the Subbasin (74 percent; 1,185,451 acres) has no amount of protection. Lands owned by WDFW fall within the medium and low protection status categories and include six wildlife management areas (Figure 51 Protection status and WDFW managed lands of the UMM Subbasin, WA.

Table 41) The Swakane and Quincy Wildlife Areas have only a small percentage of their lands in the UMM and will be examined in the Entiat and Crab Creek Subbasins, respectively.



(DCTLS 2004)

Figure 51 Protection status and WDFW managed lands of the UMM Subbasin, WA.

Table 41 Wildlife areas owned and managed by WDFW in the UMM Subbasin, WA.

Wildlife Area	Size (acres)
Colockum	88,000
Quilomene	17,803
Whiskey Dick	28,549
Chelan Butte	8,200
Wells	8,447
Sagebrush Flats	10,171

Colockum Wildlife Area

The Colockum Wildlife Area is located in the geographic center of the state in portions or Chelan and Kittitas Counties. The Colockum Wildlife Area was purchased to provide winter and summer range for Rocky Mountain elk and other wildlife species such as mule deer, California bighorn sheep, chukar, California quail, spruce, ruffed and blue grouse, mourning dove and other wildlife.

The ownership pattern of this Wildlife Area is largely every other section, with WDFW owning about 43,000 acres and the WDNR owning about 41,000 acres. Washington Department of Fish and Wildlife also manages 11,023 acres of BLM land through a memorandum of understanding.

Current management of the Colockum Wildlife Area strives to protect a large area of relatively good condition shrubsteppe, riparian, and forest habitats that provide winter and summer range for big game, game bird and other wildlife species. Human disturbance, motorized vehicle use, trespass livestock, and fire-degraded habitats, encourage noxious weeds and displace wildlife. Small and large private land holdings can increase weed and disturbance problems through vehicle use and overgrazing. Future management goals include restoration of native riparian wetlands and shrubsteppe vegetation communities where they have been damaged by overgrazing, fire or disturbance.

The Wildlife Area is managed to protect and maintain the existing, primitive environment. When the Wildlife Area was purchased, over 600 miles of roads existed. In 1972, many miles of roads were closed to improve habitat conditions for fish and wildlife, while still providing recreational opportunities. Existing roads are minimally maintained to keep public use at a reasonable level with wildlife use of the area. About 35 miles of fencing is maintained each year to control trespass livestock. Regulatory, directional, and boundary sign maintenance is needed on approximately 50 miles of boundary and 150 miles of road. Approximately 1,300 acres of agricultural fields are enrolled in CRP, while another 150 acres are actively farmed in grain production for wildlife. All agricultural land, camping areas, and about 20 miles of roadsides are managed to control noxious weeds each year. Artificial feeding of upland and nongame birds is accomplished using 29 feeders. Ten guzzlers are maintained, along with new and existing spring developments. Mountain meadows are being managed to provide elk forage by removal of conifer seedlings, while mature forests are maintained as cover for big game and other wildlife species.

The Colockum Wildlife Area fills an important role in the fish and wildlife management strategy for the Subbasin by addressing the local decline of quantity and quality of shrubsteppe habitat and its associated wildlife species. The thousands of acres of big game winter range also help alleviate damage problems caused by elk and deer to private agricultural crops. This large undeveloped block of habitat also may function as a habitat linkage for threatened species such as sage grouse. Excluding livestock grazing from riparian areas in Colockum Creek, Tekison Creek and Brushy Creek improves habitat for fish, reduces water temperatures and reduces siltation in these tributaries to the Columbia River.

Quilomene/Whiskey Dick Wildlife Area

The first land acquisition in what would become the Quilomene/Whiskey Dick Wildlife Area was in 1962 when the Washington State Department of Game purchased 11,179 acres of rangeland in the Quilomene area. Subsequent purchases were 17,055 acres in the Whiskey Dick area in 1966, and 343 acres in the Quilomene in 1974. All funding for purchase was made available by the Interagency Committee for Outdoor Recreation (IAC Grant Program). The purpose of these acquisitions was to expand the winter range for the Colockum deer and elk herds and to perpetuate and improve the upland game bird habitat. Additionally, 16,591 acres are leased from the WDNR. The combined acreage under WDFW control for both the Quilomene and Whiskey Dick areas is 45,169.74 acres. This Wildlife Area is managed as part of the L.T. Murray/Wenas Wildlife Area.

The majority of the arid Quilomene/Whiskey Dick Wildlife Area is comprised of shrubsteppe habitat (both the grassland and shrubland cover types) with riparian wetland habitat along stream corridors. Timber resources are confined to small areas along the western boundary of the Quilomene and comprise only about 250 to 300 acres. The Wildlife Area is located approximately 15 miles northeast of the city of Ellensburg in Kittitas County. The Quilomene and Whiskey Dick segments are disjunct, with the privately owned Skookumchuck drainage dividing them.

In addition to being valuable winter and transitional range for deer and elk, the Quilomene/Whiskey Dick Wildlife Area provides habitat for many other species, including bighorn sheep, sage grouse, and a myriad of small mammals, neo-tropical migratory songbirds, upland game birds, raptors, and reptiles. Widespread diversity of shrubs, trees, and grassland vegetation exists, although noxious weeds are an issue along road corridors and in areas heavily impacted by past grazing practices. Weed control is a high priority on the Wildlife Area.

Project work on the Quilomene/Whiskey Dick Wildlife Area addresses declining quantity and quality of shrubsteppe habitat and subsequent negative impacts on the distribution and populations of shrubsteppe obligate species such as sage grouse, Washington ground squirrels, sage thrashers, sage sparrows, Brewer's sparrows, loggerhead shrikes, and ferruginous hawks within a portion of the Subbasin (Vander Haegen et al. 2000, WDFW 2000). Many of these species have been adversely impacted by habitat conversion to alternate uses, such as livestock grazing, and both irrigated and dry land agriculture; water conversion to alternate uses; water impoundments associated with dams; and urban/residential development resulting in current distributions that are dramatically reduced from their historic ranges.

Wildlife Area management activities address the following habitat/landscape concerns:

Habitat Fragmentation: The Quilomene/Whiskey Dick Wildlife Area is made up of the 11,522-acre Quilomene portion to the north and the 17,055-acre Whiskey Dick portion to the south. They are separated by a 1 to 2 ½-mile-wide strip of private land known as the Skookumchuck, and interspersed throughout both portions are 16,591 acres of WDNR ownership.

Loss of Deep Soil Communities: Planning is being done to re-establish native vegetation on approximately 50 acres of deep soils formerly used as agricultural fields or for intensive livestock grazing. This will take place beginning in Fall 2003 and continue through 2005.

Livestock Grazing: Grazing on the Wildlife Area was discontinued in 1980 and will only be used as a management tool to accomplish specific habitat objectives in accordance with WDFW guidelines. The majority of the boundary of the Wildlife Area is fenced with stock fence, protecting habitats from trespass livestock grazing, and controlling off-road vehicle access.

Exotic Plant Species: Approximately 500 acres are treated annually to reduce non-native weedy vegetation, including a minimum of 35 miles of roadside treatment. Treatments include herbicides, mechanical measures, and biological agents. Where needed, native grasses are planted in treated areas to supplant weedy vegetation.

Increased Fire Frequency: Uncontrolled wildfires can significantly alter the landscape by eradicating sagebrush, which shrubsteppe obligate species, such as sage grouse, depend on for both food and cover. The Wildlife Area is outside of the fire district, and fire-fighting contracts to ensure timely response to wildfires by local fire districts or WDNR are not currently in place. Negotiations are underway to address that need, and it is hoped that contracts will be in place by the 2004 fire season.

Shrubsteppe, the predominant habitat type found on the Wildlife Area, includes both the grassland and shrubland cover types. Wildlife and habitat management activities focus primarily on improvement of shrubsteppe habitat to aid in the recovery of sage grouse. Sage grouse were historically found in shrubsteppe habitats throughout eastern Washington, but have declined 77 percent between 1960 and 1999. The current population in Washington is estimated to be about 1,000 (Schroeder et al. 2000b).

Approximately 25 miles of stock fence has been maintained to guard against livestock trespass, protect shrubsteppe habitat, and restrict vehicular access into sensitive areas, thereby maintaining critical shrubsteppe habitat for obligate species. Approximately 5 miles of interior fencing has been removed to reduce potential wildlife injury/mortality because of entanglement and collision with unneeded barbed wire. Fencing protects habitat against damage that reduces herbaceous cover used for nesting and foraging. The restriction of vehicle access, and livestock trespass also reduces the spread of undesirable weedy vegetation.

Weed control on the Wildlife Area has been an increasingly successful endeavor with the yearly improvement to spray equipment, use of GPS data for locating new sites and relocating past areas of treatment, and cooperative efforts with Kittitas County. Russian knapweed has been nearly eradicated in several areas, and treatment to whitetop, Dalmatian toadflax, several species of thistle, diffuse knapweed, pepperweed, and other noxious weed species is meeting with success as well.

When livestock grazing was practiced on the Wildlife Area, numerous springs were developed to promote the dispersal of stock throughout the area and avoid concentrated use in the riparian corridors, those being the only places in which stock water was in abundance. Eleven of those springs have been maintained for use by wildlife. This allows the expanded use of the Wildlife Area by deer and elk for winter and transitional range, as well as use by other small mammals and a variety of birds and game birds.

Photo monitoring within the Wildlife Area began in the early 1980s, and is still ongoing to document the changes associated with the removal of livestock grazing. Photo monitoring began in 2003 on treated noxious weed sites, particularly those under consideration for being replanted with native or native-like seed to ensure that new weeds are not introduced.

The Wildlife Area contains approximately 65 miles of Green Dot designated roads managed through a cooperative agreement with WDFW, WDNR, USFS, and other agencies. These roads are open for vehicle travel. All other roads are closed, and cross-country vehicle travel is prohibited year-round.

Chelan Butte Wildlife Area

Restoration and Weed Control: Wildlife Area managers have conducted weed control activities on approximately 370 acres of agricultural fields in an attempt to restore permanent cover for shrubsteppe obligate wildlife species. Heavy infestation of weeds hampered restoration efforts and weed control eliminated some potential for shrub and forb establishment. The initial helicopter seeding was successful in establishing 150 of 300 acres. Approximately 150 acres were missed in the first seeding and an additional 7 acres were re-seeded in the fall of 2002.

Fence Construction and Maintenance: Wildlife Area managers surveyed property boundaries and constructed about 2.5 miles of fence in the Entiat area. This project was designed to establish Wildlife Area boundaries and protect shrubsteppe and riparian wetland communities from trespass livestock. This project will reduce the extent of livestock trespass and minimize disturbance, which facilitates weed encroachment and native habitat deterioration.

Wells Wildlife Area

Riparian Habitat Restoration: Wildlife Area managers are restoring woody riparian habitat by establishing an average of 5,500 native shrubs and trees annually. This project is designed to address the loss of woody cover by increasing ecological diversity. Beaver, deer and small mammals damaged some woody plantings. Much of the 2002 plantings were overwhelmed by weeds and about 25 percent had to be replaced in 2003.

Wildlife Food Plots: Wildlife Area managers plant, irrigate and maintain approximately 80 acres of grain crops, including 10 to 15 acres of corn annually. This project is designed to provide food for waterfowl during critical periods and increase hunting opportunity on and off the Wildlife Area.

Canada Goose Nesting Surveys: The WDFW conducts annual goose nesting surveys on Wells Pool. Estimated production for the years 1998 through 2002 were 494, 565, 680, 877 and 653. Approximately 40 percent of the production originates from artificial nesting structures provided and maintained by WDFW. This project is designed to address the lack of goose nesting habitat.

Kestrel Nesting Box Project: Wildlife Area managers maintain approximately 50 kestrel nesting boxes to increase nesting habitat and reduce rodents. Recorded annual production between 1998 and 2001 was 113, 66, 149 and 90 young (about 4.5 young per nest surveyed).

Pond Construction: Wildlife Area managers constructed 10 small impoundments to increase wetland habitat and ecological diversity. Managers successfully created temporary ponds and increased wetland habitat and "sub-irrigated" areas.

Integrated Noxious Weed Management: Wildlife Area managers implement integrated weed control activities, including the annual treatment of 80 acres of noxious weeds with herbicide; annual mowing of about 25 acres; the release of 9,550 bio-control agents between 1998 and 2002; and seeding disturbed areas to permanent cover. These activities are designed to reduce competition with native plant species and increase ecological diversity. Managers have successfully reduced noxious weeds and prevented their spread to adjacent areas. Bio-control shows promises for weed control without the loss of plant diversity associated with some herbicide treatments. It also appears to be the most cost-effective method in the long-term in hard-to-reach areas.

Upland Habitat Restoration: Wildlife Area managers reseeded 65 acres of burned areas and associated firebreaks with a native seed mixture that includes bitterbrush. This project is designed to restore shrubsteppe plant communities and deer browse. To date, the success of bitterbrush seeding has been very low.

Sagebrush Flats Wildlife Area

The 8,775-acre Sagebrush Flat Wildlife Area (SFWA) is located in Douglas County, Washington and is comprised of four disjunct parcels (Units) owned and/or managed by WDFW. The SFWA includes the 3,740-acre Sagebrush Flat Unit, the 320-acre Dormaier Unit, the 2,206-acre Chester Butte Unit, and the 2,509-acre West Foster Creek Unit. The SFWA is predominantly shrubsteppe habitat and was acquired to promote recovery of pygmy rabbits, sage grouse, and sharp-tailed grouse as well as to protect/provide habitat for other shrubsteppe obligate species. The Sagebrush Flat, Dormaier, and Chester Butte Units are managed primarily for pygmy rabbits, sage grouse, and mule deer while the West Foster Creek Unit was acquired to protect sharp-tailed grouse, sage grouse, and mule deer habitat.

Since 1998, 400 acres of agricultural land have been converted to permanent habitat through the use of CRP. An additional 120 acres of low quality crested wheatgrass fields are currently being converted to high quality permanent habitat. The benefits of this project are unknown until these areas reach maturity in 7-15 years.

Using Bonneville Power Administration funding, WDFW implemented a pygmy rabbit enhancement project within the SFWA. The project is designed to enhance conditions for pygmy rabbit burrow sites and duplicate the habitat features favored by the pygmy rabbits on the Sagebrush Flat unit and surrounding areas. Results are unknown at this time.

Since 1998, SFWA staff and WSCC crews have planted approximately 10,500 trees and shrubs to enhance riparian areas of the West Foster Creek unit and to increase winter habitat for sharp-tailed grouse (Peterson, pers. comm., 2003). Planting results are unknown at this time.

Biologists have been successful at reducing the size and distribution of weed infestations on the SFWA. In the last two years 6,200 bio-agents (Mecinus janthinus) have been released to treat infestations of Dalmatian toadflax and provide long term, cost effective treatment of this weed (Peterson, pers. comm., 2003).

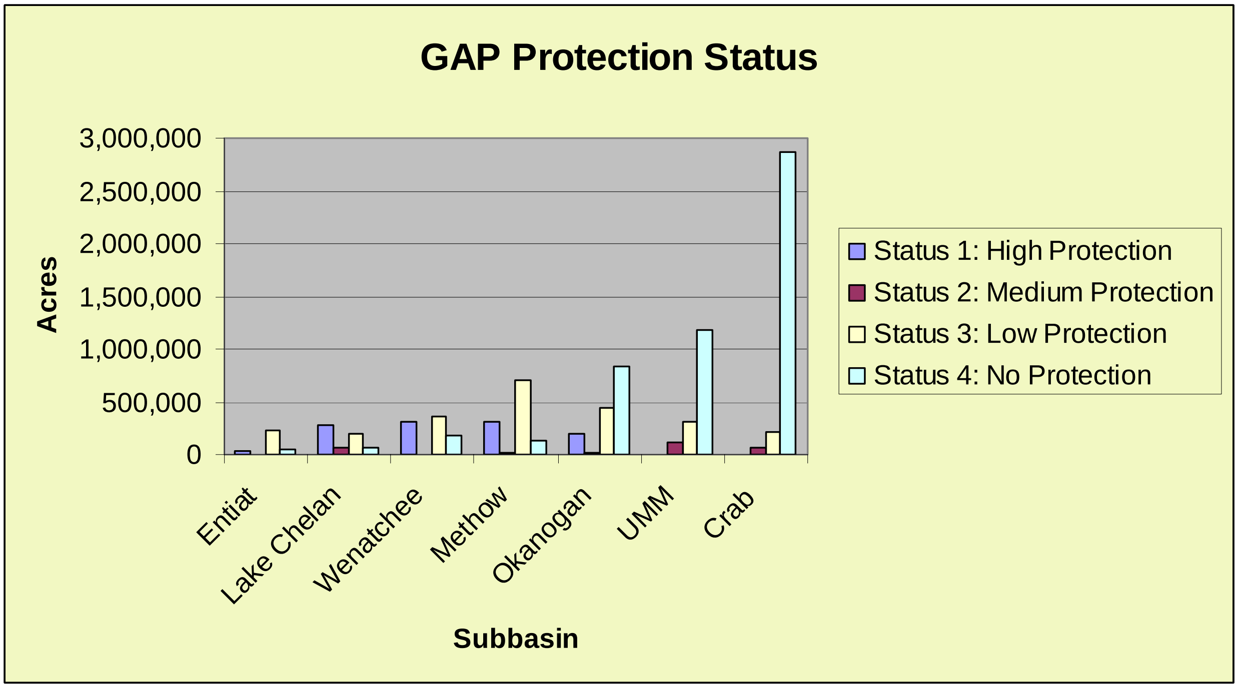
Fire protection contracts have been secured with 4 local fire districts to prevent the catastrophic loss of habitat because of wildfire (Peterson, pers. comm., 2003). A fire in the Sagebrush Flat unit would eliminate the last remaining wild population of pygmy rabbits in the state. On the Sagebrush Flat unit, 17 miles of firebreaks have been built around and within the area. Additionally, a water reservoir was constructed on the unit for fire fighting crews and helicopters.

Washington State University (WSU) conducted a three-year study designed to evaluate the effects of four grazing treatments on vegetation and pygmy rabbit behavior. Results of the study showed 1) pygmy rabbits ate more grasses and forbs in the ungrazed areas than in grazed areas; 2) there was a clear movement by rabbits from grazed areas to ungrazed areas; 3) nutritional quality of pygmy rabbit forage was greater on the ungrazed areas than the grazed; and 4) cattle grazing caused the collapse of burrows built and used by the pygmy rabbit (Peterson, pers. comm., 2003). Study results will be used to prioritize areas within the Subbasin that are suitable for pygmy rabbit reintroduction as well make sound, science based management decisions regarding the use of cattle grazing in pygmy rabbit habitat.

The WDFW, WSU and the FWS implemented a pygmy rabbit captive breeding program to address a rapidly declining and genetically depressed wild population of pygmy rabbits. In the last three years, the program has established breeding and rearing facilities located at WSU, Northwest Trek, and the Oregon Zoo. All the animals captured for the program were taken from the Sagebrush Flat unit – the last known location in Washington where pygmy rabbits are known to occur. The WDFW has conducted an assessment of the genetics and interrelatedness of the local population and populations in Idaho and Montana. The captive breeding facilities have had some success in breeding Washington pygmy rabbits, however, complications because of the inbred nature of the population and disease are serious challenges within the Program (Peterson, pers. comm., 2003).

GAP Protection

GAP protection status acreage for each CCP subbasin is compared in Figure 52. As illustrated, the UMM Subbasin and the Crab Subbasin are the only subbasins in the CCP without high protection status lands (status 1). Medium, low, and no protection status lands (status 2, 3, and 4 respectively) show similar trends as those found in other CCP subbasins.



(IBIS 2003)

Figure 52 GAP protection status for all CCP/subbasin habitat types

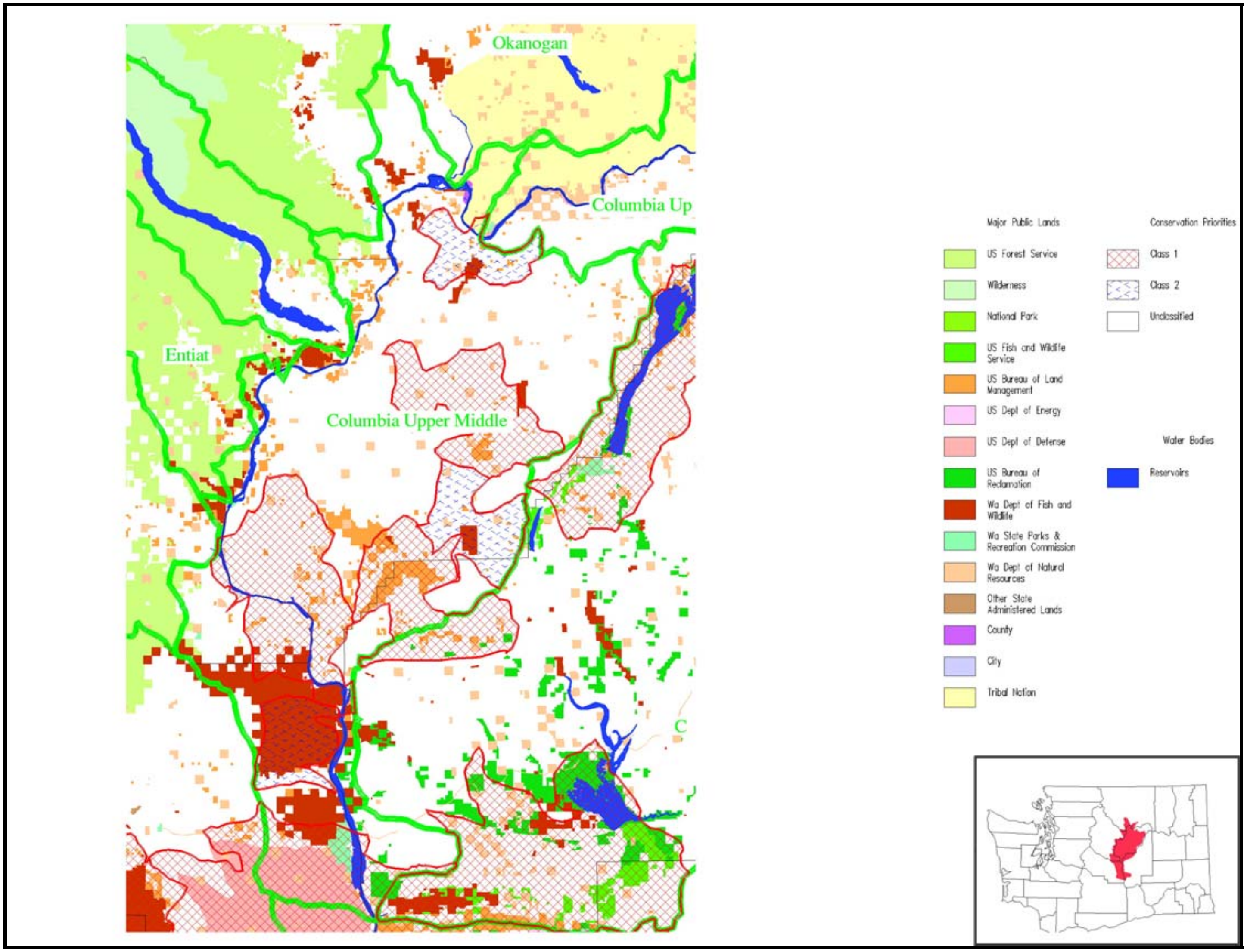
Conservation Reserve Program

Additional habitat protection, primarily on privately owned lands, is provided through the Conservation Reserve Program (CRP). The CRP is intended to reduce soil erosion on upland habitats through establishment of perennial vegetation on cropland. This program provides short-term (10 years), high protection of habitats enrolled. The U.S. Congress authorizes program funding /renewal, while the USDA determines program criteria. Program enrollment eligibility and sign-up is decentralized to state and local NRCS offices (Hamilton, pers. comm., 2003).

Ecoregion Conservation Assessment Priorities

Subbasin ECA priorities and public land ownership are illustrated in Figure 53. The Ecoregion Conservation Assessment is further discussed in section 4.2 of Ashley and Stovall (unpub. rpt., 2004). An extensive area of shrubsteppe in the central portion of the Subbasin is comprised of ECA class 1 lands. Three areas in the Subbasin, comprised largely of shrubsteppe habitat owned and managed by WDFW, are designated ECA class 2. The majority of these class 2 lands are provided some threat protection primarily through public ownership. WDFW ECA planners, with local input, may identify additional shrubsteppe habitats as ECA priority areas when ECA data are updated (TNC 1999).

Subbasin planners can use ECA data, in conjunction with other tools such as IBIS and Streamnet, to identify areas in which to focus protection strategies and conservation efforts. Protection of critical habitats on private lands, located adjacent to existing public lands, within ECA designated areas is a high priority within the Subbasin and CCP (TNC 1999).



(TNC 1999)

Figure 53 ECA and publicly owned lands in the UMM Subbasin, WA.

5.1.3 Existing Programs, Plans, and Policies

(This section taken from Ashley and Stovall, unpub. rpt., 2004 except as noted)

Tribal Programs, Plans, and Policies

Confederated Tribes of the Colville Reservation (Colville Tribes)

Approximately 30,000 acres of the Subbasin lies within the exterior boundaries of the Reservation of the Colville Tribes. The Colville Tribes Natural Resource Department, Fish and Wildlife Program, has grown and evolved considerably since 1975. This has allowed the Tribes to broaden their management objectives and participate more effectively with other government entities both on and off the Colville Reservation. A common element limiting the effective management of Tribal resources is the need for clear and developed habitat and species management plans. All programs within the Colville Tribes Natural Resource Department have recognized this need, and the Department is currently in the process of developing program wide management plans. The intent of these plans is to aid in integrating natural resource management with other land use practices such as timber harvest, grazing, and development.

Game Management Program

Big game management on the Colville Reservation and throughout the Subbasin is a priority to tribal members. Management and harvest is conducted for the purpose of subsistence. Big game meat is a primary component of many traditional and cultural activities.

Big game helicopter survey flights have been conducted annually since 1985, depending on funding. Deer and elk populations are the primary focus of these surveys, but moose and wild horse information is collected incidentally. The Colville Tribes have used a sightability model since 2000 to estimate deer and elk populations. Not only have the sightability surveys produced reliable deer and elk numbers, but species locations are also entered into the global positioning system. The information has been helpful for identifying critical ranges; prioritizing land acquisitions; and providing input into timber harvests, road construction and other land management operations.

Hellsgate Mitigation Program

The Hellsgate Mitigation Program was established to address habitat and species losses on the Colville Reservation as the result of hydropower development. Under the auspices of this program, the Colville Tribes acquire degraded agricultural lands with the intent of restoring them to functioning native plant communities to meet the habitat and species desires of the tribal membership. Once acreages are identified for potential of acquisition, a Habitat Evaluation Procedure is conducted to assess habitat condition for selected species. Operations and maintenance is conducted to eliminate livestock grazing and control noxious weeds (Priest, pers. comm., 2004).

Hunting Seasons: Tribal Member and Non-Tribal Member

The Colville Tribe's Fish and Wildlife Department develops hunting regulations for tribal and non-tribal members. The Colville Business Council ratifies seasons, bag limits and possession limits.

Deer, elk, and forest grouse are the most highly pursued species by Colville Tribal members. Other game and predators such as cougar, bobcat, and beaver are either hunted or trapped. Ceremonial harvest for deer and elk occurs year round for cultural activities such as winter dances, funerals, blessings and subsistence.

Non-tribal hunting seasons are established in designated areas for upland game birds, waterfowl and migratory birds. Non-tribal members may also harvest rabbits. Non-tribal members must possess a non-tribal hunting permit before hunting.

Integrated Resource Management Plan

The IRMP was developed in 1999 to guide in the management of natural resources on the Colville Reservation. Indian people's well-being is tied to the well-being of the natural resources (mother earth and all her children) (Colville Tribes 1999). The scope of the IRMP covers the management of the resources that the Tribes used in the past and in the present, while ensuring the management of future resources based on Tribal values, desires, and needs. The IRMP established standards and guidelines in the management of wildlife, fisheries, water, forest and range habitats, and populations.

Timber, Fish and Wildlife Program

The Timber, Fish and Wildlife Program is a consensus based, stakeholder group that grew from the Bolt Decision. This program focuses primarily on forest practices on state and private lands. Some of the representative caucuses include the Colville Tribes, large industries, small landowners, state agencies, federal services and environmental groups. The Colville Tribes are a leader in the development of the Forest and Fish Report (1999) and in designing forest practice standards and guidelines for eastern Washington. Activities include participating on interdisciplinary teams and conducting research to test the effectiveness of the harvest prescriptions in meeting clean water, fish and species diversity.

Columbia River Inter-Tribal Fish Commission (CRITFC)

Columbia River Anadromous Fish Restoration Plan: Wy-Kan Ush-Mi-Wa-Kish-Wit

The CRITFC represents the combined interests for the Nez Perce, Umatilla, Warm Springs, and Yakama Tribes. The tribal Columbia River Anadromous Fish Restoration Plan, or Wy-Kan-Ush-Mi Wa-Kish-Wit, was developed by CRITFC in 1995. Recommendations set forth in this plan for salmon recovery address three types of actions: institutional, technical, and watershed, with the over-riding goal of simply putting fish back in the river (gravel to gravel management) (Kaputa and Woodward 2002).

Federal Programs, Plans, and Policies

Bonneville Power Administration

The BPA is a federal agency established to market power produced by the federal dams in the Columbia River Basin. The BPA provides funding for fish and wildlife protection and enhancement to mitigate for the loss of habitat resulting from hydroelectric construction and operations.

Bureau of Land Management

The Bureau of Land Management (BLM) manages lands in Douglas, Grant, Chelan and Kittitas Counties. The lands are managed for multiple uses including habitat for native wildlife.

Riparian Habitat Protection and Enhancement

The BLM continues to protect and manage riparian habitat in the Subbasin to enhance riparian habitat and water quality from season-long livestock grazing. Protection allows for proper functioning of healthy riparian systems including silt and sediment entrapment, aquifer recharge, erosion abatement, and fish and wildlife habitat.

Among the accomplishments of the riparian protection project, BLM has constructed multiple riparian exclosures to protect 8 miles of riparian habitat. Monitoring Avian Survivorship and Productivity (MAPS) for nine years has documented 65 breeding birds within the Douglas Creek exclosure. Proper Functioning Condition (PFC) surveys, water quality monitoring, and macro-invertebrate studies have recorded high quality watershed and riparian conditions.

Upland Shrubsteppe Restoration and Management

The BLM acquires and manages shrubsteppe habitat for shrubsteppe obligate species including Washington ground squirrel and sage grouse. This project is meant to improve the condition of shrubsteppe habitat and restore degraded and converted cropland. Restoration and management activities include improving grazing management practices through rotational grazing and reduced stocking rates; controlling weeds through spraying and vehicle management (road closures); collecting native grass seeds to create commercially available seed sources; and developing and testing land treatment methods (e.g., mowing, herbicide application, plowing, seeding) to establish native shrubsteppe plant communities on degraded and converted lands. Project accomplishments include: collection of six native grasses and 20 forbs for commercial grow-out; development of grazing plans for three major allotments affecting over 20,000 acres of shrubsteppe habitat; annual herbicide applications to noxious weeds along roads and trails; mowing of 160 acres as a first step in converting CRP to native shrubsteppe; and seeding of 160 acres of acquired agricultural land.

Wildlife Habitat/Population Monitoring and Evaluation

The BLM is currently implementing monitoring and evaluation activities in the Subbasin, including a MAPS study in Douglas Creek; the effects of CRP restoration on songbirds, small mammals and sage grouse habitat; sensitive species inventories for Washington ground squirrel and pygmy rabbit; an evaluation of bighorn sheep habitat for reintroduction; and bald eagle winter roost monitoring.

The BLM monitoring and evaluation project addresses the long-term population trends of neotropical birds; the effects of CRP restoration on songbird and small mammal composition and abundance; the structure and quality of sage grouse habitat; the distribution of Washington ground squirrels and presence of pygmy rabbits on or near BLM lands; and the feasibility of bighorn sheep reintroduction.

Project accomplishments include nine years of bird monitoring; location of Washington ground squirrels in 20 sections of land; and 18 years of roost monitoring.

National Marine Fisheries Service

NMFS administers the ESA as it pertains to anadromous fish. Two listed ESUs migrate through the Columbia River: upper Columbia River spring Chinook salmon and upper Columbia River steelhead.

Under Sections 7 and 10 of the ESA, "take" of listed species is prohibited and permits are required for handling. Special permit applications have been pursued for research and management activities in the UMM. Recovery actions for listed species also require Fisheries Management and Evaluation Plans.

The FCRPS BiOp and the Basinwide Salmon Recovery Strategy (All-H Paper) contain actions and strategies that are specific to the UMM. Other aspects of hatchery and harvest management apply as well. Action agencies are identified that will lead fast-start efforts in specific aspects of restoration on nonfederal lands. BiOps, recovery plans, and habitat conservation plans for federally listed fish and aquatic species help target and identify appropriate watershed protection and restoration measures (Kaputa and Woodward 2002).

Natural Resource Conservation Service (NRCS)

One of the purposes of the NRCS is to provide consistent technical assistance to private land users, tribes, communities, government agencies, and conservation districts. The NRCS assists in developing conservation plans, provides technical field-based assistance including project design, and encourages the implementation of conservation practices to improve water quality and fisheries habitat. Programs include the CRP, River Basin Studies, Forestry Incentive Program, Wildlife Habitat Improvement Program, the Environmental Quality Incentives Program, and Wetlands Reserve Program. The USDA Farm Services Administration (FSA) and the NRCS administer and implement the federal CRP and Continuous CRP.

Conservation Innovation Grants (CIG)

CIG is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging federal investment in environmental enhancement and protection, in conjunction with agricultural production. Under CIG, EQIP funds are used to award competitive grants to non-federal governmental or non-governmental organizations, Tribes, or individuals. CIG enables NRCS to work with other public and private entities to accelerate technology transfer and adoption of promising technologies and approaches to address some of the Nation's most pressing natural resource concerns. CIG will benefit agricultural producers by providing more options for environmental enhancement and compliance with federal, state, and local regulations. The USDA oversees CIG and the NRCS administers the program.

Conservation Reserve Program (CRP)

The CRP provides technical and financial assistance to eligible farmers and ranchers to comply with federal, state, and tribal environmental laws and to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program is funded through the Commodity Credit Corporation. CRP is administered by the Farm Service Agency, with NRCS providing technical land eligibility determinations, Environmental Benefit Index Scoring, and conservation planning (Bareither, pers. comm., 2004).

The enrollment of agricultural land with a previous cropping history into CRP has removed highly erodible land from commodity production. The land is converted into permanent herbaceous or woody vegetation to reduce soil and water erosion. Farmers receive an annual rental payment for the term of the contract (Bareither, pers. comm., 2004), a maximum of 10 years (the contracts may be extended). Cover Practices that occur under CRP include planting introduced or native grasses, wildlife cover, conifers, filter strips, grassed waterways, riparian forest buffers, and field windbreaks. There are 177,910 acres of CRP in the Subbasin.

CRP contract approval is based, in part, on the types of vegetation landowners are willing to plant. Cover Practice planting combinations are assigned points based on the potential value to wildlife. For example, cover types more beneficial to wildlife are awarded higher scores. Seed mixes containing diverse native species generally receive the highest scores (FSA 2003).

CRP and associated cover practices that emphasize wildlife habitat increase the extent of shrubsteppe-like habitat, provide connectivity/corridors between extant native shrubsteppe and other habitat types, reduce habitat fragmentation, increase landscape habitat diversity and edge effect, reduce soil erosion and stream sedimentation, and provide habitat for wildlife species.

Continuous Conservation Reserve Program (CCRP)

The CCRP focuses on the improvement of water quality and riparian areas. Practices include shallow water areas with associated wetland and upland wildlife habitat, riparian forest buffers, filter strips, grassed waterways and field windbreaks. Enrollment for these practices is not limited to highly erodible land, as is required for the CRP, and carries a longer contract period (10 - 15 years), higher installation reimbursement rate, and higher annual annuity rate.

Environmental Quality Incentives Program (EQIP)

The EQIP was established in the 1996 Farm Bill and was reauthorized in the Farm Security and Rural Investment Act of 2002 (Bareither, pers. comm., 2004). The EQIP is administered and implemented by the NRCS and provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program assists farmers and ranchers with federal, state, and tribal environmental compliance, and encourages environmental stewardship. The program is funded through the Commodity Credit Corporation.

Program goals and objectives are achieved through the implementation of a conservation plan that incorporates structural, vegetative, and land management practices on eligible land. Eligible producers commit to 5 to 10-year contracts. Cost-share payments are paid for implementation of one or more eligible structural or vegetative practices such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Furthermore, incentive payments are made for implementation of one or more land management practices such as nutrient management, pest management, and grazing land management.

Public Law 566 Small Watershed Program (PL 566)

PL 566 can be leveraged with other federal, state, or local program funds to provide wildlife and fisheries protection. Soil and water conservation districts using other project funding sources leverage NRCS program resources in combination to concentrate conservation within watersheds of concern.

Wetlands Reserve Program (WRP)

This voluntary program is designed to restore wetlands. Participating landowners can establish permanent or 30-year conservation easements, or they can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetlands. The 30-year easement payment is 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The voluntary agreements are a minimum of 10 years in duration and provide for 75 percent of the cost of restoring the involved wetlands. The goal of NRCS is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program (Bareither, pers. comm., 2004). This program establishes wetland protection and restoration as the primary land use for the duration of the easement or agreement (Ashley and Stovall 2004) and establishes long-term conservation and wildlife practices and protection (Bareither, pers. comm., 2004). There are no Wetland Reserve Program projects within the Subbasin.

Wildlife Habitat Incentive Program (WHIP)

The WHIP is administered and implemented by NRCS and provides financial incentives to develop wildlife habitat on private lands. Participants agree to implement a wildlife habitat development plan and NRCS agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. The NRCS and program participants enter into a cost-share agreement for wildlife habitat development. This agreement generally lasts a minimum of 10 years.

U. S. Army Corps of Engineers

Chief Joseph Dam/Rufus Woods Lake Wildlife Mitigation Project

In the mid-1970s, Congress authorized additional hydropower generating units and a pool raise at Chief Joseph Dam. This construction was complete in 1981 and the pool raise occurred that year. Prior to the pool raise, the Corps worked with the FWS, WDFW, and the Colville Tribes to determine specific habitat losses that would occur as a direct result of inundation from the new pool level. Congress approved a habitat mitigation plan in 1980 and implementation was initiated the following year.

The project included development of 16 mitigation sites on Rufus Woods Lake. Six sites include approximately 105 acres of planted and irrigated trees and shrubs. Over 200,000 plants have been placed to date. Other sites (totaling about 1400 acres) include goose nesting structures, raptor perching/nesting structures, goose brooding pastures, and cattle exclusion fences. The program manages approximately 1,500 acres. Research projects onsite include breeding bird, small mammal, and bat surveys, wetland inventory, and plant studies. Several habitat evaluation studies to determine success of habitat creation/management have also occurred. The sites are on a combination of public, tribal, and private lands.

Many aspects of the mitigation plan have been evaluated either casually or through formal surveys. Success has been accomplished in developing quality wildlife habitat through planting and elimination from grazing at specific areas. Enhancement projects include over 10 miles of cattle exclusion fencing, 35 goose nesting structures and over 100 additional nesting areas (e.g., rock cribs on haystack rock islands), 25 duck nesting tunnels, 49 raptor perching/nesting poles, and 6 acres of mowed goose brooding area. A major focus of the program is noxious weed control with primary species being knapweeds and toadflax with sporadic areas of hounds tongue (Ashley and Stovall, unpub. rpt., 2004).

U. S. Department of Agriculture (USDA)

This section provided by M. Bareither, pers. comm., 2004

The USDA oversees several conservation programs to help solve natural resource concerns. In addition to those listed below, the USDA oversees the following programs administered by the NRCS: CIG, CRP, EQIP, WHIP, WRP (See NRCS above).

Conservation Security Program (CSP)

CSP is a voluntary conservation program to support ongoing conservation stewardship of agricultural lands by providing payments to producers who maintain and enhance the condition of natural resources. CSP will identify and reward those enrolled farmers and ranchers who are meeting the highest standards of conservation and environmental management.

Grassland Reserve Program (GRP)

The GRP is a voluntary program offering landowners the opportunity to protect, restore, and enhance grasslands on their property. Section 2401 of the Farm Security and Rural Investment Act of 2002 (Pub. L. 107-171) amended the Food Security Act of 1985 to authorize this program. The NRCS, FSA, and USFS are coordinating implementation of GRP, which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.

Resource Conservation & Development Program (RC&D)

The purpose of the RC&D program is to accelerate the conservation, development, and utilization of natural resources, improve the general level of economic activity, and to enhance the environment and standard of living in designated RC&D areas. It improves the capability of state, tribal and local units of government and local nonprofit organizations in rural areas to plan, develop, and carry out programs for resource conservation and development. The program also establishes or improves coordination systems in rural areas. Current program objectives focus on improvement of quality of life achieved through natural resources conservation and community development, which leads to sustainable communities, prudent use (development), and the management and conservation of natural resources. RC&D areas are locally sponsored areas designated by the Secretary of Agriculture for RC&D technical and financial assistance program funds.

U.S. Fish and Wildlife Service (FWS)

The FWS administers the ESA as it pertains to resident fish and wildlife. In June 1997, the FWS listed bull trout as threatened in the upper Columbia River. The biological opinion for bull trout specifies needed actions for their recovery. On March 5, 2003, the FWS listed the Columbian Basin distinct population segment of the pygmy rabbit as endangered. Recovery planning for pygmy rabbits is currently underway. The FWS reviews and comments on land use activities that affect fish and wildlife resources such as timber harvest, hydroelectric projects, flow alterations, and dredging and filling wetlands. The federal Migratory Bird Act also protects migratory birds and their habitats.

U.S. Forest Service (USFS)

The USFS manages land in the Entiat Ranger District in the Wenatchee portion of the Wenatchee National Forest. The land is managed according to the Wenatchee National Forest Land and Resource Management Plan (Forest Plan) (USDA 1990). The Forest Plan divides the land into management areas, each with a management prescription based on unique habitat conditions. The majority of National Forest land in the Subbasin is managed for multiple uses, including deer and elk winter range, timber production, livestock grazing, recreation, and research.

State Programs, Plans, and Policies

Washington Department of Ecology (Ecology)

Ecology's mission is to protect, preserve, and enhance Washington's environment and promote the wise management of air, land, and water for the benefit of current and future generations. The agency is responsible to set and monitor regulatory standards for water quality within the subbasin. Ecology provides support for watershed management in the subbasin, and is responsible for instream flow rule development and shoreline, floodplain, wetland, and water resource management.

Ecology and partner governments and agencies are monitoring many water quality attributes on the Columbia River Columbia River. Region 10 of the U.S. Environmental Protection Agency is leading efforts to address temperature listings under section 303-d of the CWA through a TMDL process. Ecology and ODEQ are leading the efforts to address TDG on the Columbia River though a total TMDL.

Watershed Management Act (WMA, ESHB 2514)

The 1998 Washington State Legislature passed the WMA (Chapter 90.82 RCW) to provide a framework for local citizens, interest groups, and government organizations to collaboratively identify and solve water-related issues in each of the 62 Water Resource Inventory Areas (WRIAs) in the state. The WMA enables local groups called "Planning Units" to form for the purpose of conducting watershed planning. Under the law, citizens, local governments, tribes, and other members of the Planning Unit must assess water resources and needs and recommend management strategies for the watershed. The Planning Unit may also assess habitat, water quality and instream flow requirements. Ecology oversees the WMA (Kaputa and Woodward 2002).

Washington Department of Fish and Wildlife (WDFW, RCW77.04.055)

The Washington Fish and Wildlife Commission is directed by the Washington State Legislature to establish policies to preserve, protect and perpetuate fin fish, shellfish, and wildlife and their habitats to maximize fish and wildlife recreational opportunities compatible with healthy and diverse fish and wildlife populations. The Mission of WDFW is: "Sound stewardship of fish and wildlife". In pursuit of this mission, WDFW strives to maximize fishing, hunting and non-consumptive recreational opportunities compatible with healthy, diverse fish and wildlife populations. A few of the important policies, plans, and guidelines that drive WDFW management in the UMM include a statewide strategy to recover salmon, a wild salmonid policy, management plans for steelhead and bull trout, and salmon, steelhead, and bull trout stock inventories, and wildlife management plans (e.g., pygmy rabbit, sage grouse, sharp-tailed grouse).

Elk Herd Plans

Washington state elk herd plans summarize historic and current distribution and abundance. The Department recognizes ten, distinct elk herds in the state. Five of the ten elk herd management plans have been completed. The plans address the major factors affecting abundance and persistence. Population management objectives, spending priorities, and management strategies are spelled out. Priorities for habitat enhancement are identified. The Colockum Elk Herd Plan is currently in development.

Game Management Plan

The game management plan guides WDFW's management of hunted wildlife through June 2009. The plan focuses on scientific and harvest management of game, and other factors affecting game populations. The overall goals of the plan are to protect, sustain, and manage hunted wildlife; provide stable, regulated recreational hunting opportunity to all citizens; protect and enhance wildlife habitat; and minimize adverse impact to residents, other wildlife, and the environment. The plan outlines management strategies for the following species or groups of species: Elk, Deer, Bighorn Sheep, Mountain Goat, Moose, Black Bear, Cougar, Waterfowl, Migratory Birds (e.g., Mourning Dove), Wild Turkey, Mountain Quail, Forest Grouse, Upland Game Birds, Small game (e.g., rabbits), Furbearers (e.g., beaver), Unclassified Species (e.g., coyote).

Bighorn Sheep Plan

The Washington State management plan for bighorn sheep describes the geographical range, natural history, habitat requirements and status, population dynamics and status, and management activities and implementation for 16 herds statewide. The plan identifies goals and objections for managing bighorn sheep and addresses specific issues related to monitoring, recreation, enforcement, reintroductions, research, and disease. The plan was adopted in 1995 and fits within the umbrella of the Game Management Plan for 2003-2009.

Black Bear Plan

The Washington State management plan for black bear describes the geographical range, life history, habitat, population dynamics, and management direction for bears. The plan identifies goals and objectives for managing black bear and addresses specific issues related to nuisance activity, recreation, enforcement, habitat protection, and education. The plan was adopted in 1997 and fits within the umbrella of the Game Management Plan for 2003-2009.

Interagency Waterfowl Management Plans

WDFW is a member of the Pacific Flyway Council, an organization of 11 western states that develops management recommendations for migratory waterfowl. Management plans developed by the Council include population objectives, harvest strategies, habitat recommendations, and basic biological information. The Council also participates in the development of nationwide management plans for waterfowl. The following is a list of interagency plans that deal with Washington's waterfowl resources: Pacific Flyway Management Plans - Canada Geese, Western Tundra, Sandhill Cranes, Pacific Coast, Central Valley, Mourning Doves; Related plans - North American Waterfowl Management Plan, National Mourning Dove Plan.

Joint Venture habitat plans

WDFW is an active participant in two joint ventures under the North American Waterfowl Management Plan, the Pacific Coast and the Intermountain West joint ventures. The joint ventures include representatives of agencies from all levels of government and nonprofit organizations, who are interested in conservation and enhancement of habitat for migratory birds and related fish and wildlife resources. The joint ventures have developed strategic plans to guide conservation efforts of all the partners: Pacific Coast Joint Venture Strategic Plan and Intermountain West Joint Venture Strategic Plan.

Management Recommendations (PHS)

Each species account provides information on the species' geographic distribution and the rationale for its inclusion on the PHS list. The habitat requirements and limiting factors for each species are discussed, and management recommendations addressing the issues in these sections are based on the best available science. Each species document includes a bibliography of the literature used for its development, and each has a key points section that summarizes the habitat requirements and management recommendations for the species. Management Recommendations for Washington's Priority Habitats and Species (WDFW 1999, 1997, and 1995) are detailed as follows: Volume I – Invertebrates, 1995; Volume II – Fish and Marine Invertebrates (currently in development); Volume III – Amphibians and Reptiles, 1997; Volume IV – Birds, 1999 (Updated 2004); Volume V – Mammals (currently in development).

Recovery/Management Plans

Recovery/management plans summarize the historic and current distribution and abundance of a species in Washington and describe factors affecting the population and its habitat. It prescribes strategies to recover the species, such as protecting the population, evaluating and managing habitat, and initiating research and education programs. Target population objectives and other criteria for reclassification are identified and an implementation schedule is presented. Recovery / Management Plans have been prepared for the following species or groups of species: Bald eagle, 1990, federal 1986; Bighorn sheep, 1995; Black bear, 1997; Cougar, 1997; Deer, 1997; Elk, 1997; Ferruginous hawk, 1996; Furbearers, 1987-93; Mountain quail, 1993; Pygmy rabbit, 1995; 2003; Sage grouse, 1995; 2004; Sandhill crane, 2000; Sharp-tailed grouse, 1995; Western gray squirrel, 1993; draft 2004; Waterfowl, 1997; Upland birds, 1997; and upper Columbia Steelhead Management Conservation Plan, 2001.

Status Reports

A status report includes a review of information relevant to the species' status in Washington and addresses factors affecting its status including, but not limited to: historic, current, and future population trends, natural history including ecological relationships, historic and current habitat trends, population demographics and their relationship to long-term sustainability, known and potential threats to populations, and historic and current species management activities. Status reports have been prepared for the following species: Bald eagle, 2001; Burrowing owl, draft, 2004; Common loon, 2000; Northern leopard frog, 1999; Peregrine falcon, 2002; Pygmy rabbit, 1993; Sage grouse, 1998; Sharp-tailed grouse, 1998; Streaked horned lark, draft, 2004; Washington ground squirrel, draft, 2004; and Western gray squirrel, 1993.

Upland Restoration Program (URP)

The WDFW has worked with private landowners to restore habitat within the Subbasin since 1991. The Habitat Development Program established small (0.5 to 3 acres) habitat plots primarily for upland game birds. In the 1990s, partnerships between WDFW, NRCS, conservation districts, and private landowners made possible habitat restoration projects at the watershed scale through participation in farm programs such as CRP. Today, this multi-agency/private landowner partnership continues to enhance, protect, maintain, and increase wildlife habitat throughout the Subbasin.

Through cooperative agreements with private landowners, URP biologists improve and restore riparian, upland, and shrubsteppe habitats used by both resident and migratory wildlife species within the Subbasin. Projects typically include planting shrubs and trees (for thermal and escapement cover), restoring riparian habitat, developing water sources (e.g., guzzlers, ponds, spring developments), and maintaining winter game bird feeders. WDFW works with over 190 cooperating landowners that own or control over 500,000 acres. Agreements are in place to protect or restore shrubsteppe or riparian wetland habitat on 682 sites covering over 9,000 acres. An additional 144 water source developments have been completed (R. Fox, pers. comm., 2004).

The CRP has provided WDFW with another opportunity to work with local conservation agencies and landowners to improve wildlife habitat throughout the subbasin. WDFW biologists assist landowners with selecting and/or planting herbaceous seed mixes, trees, and shrubs.

All private landowner cooperators are required to sign public access agreements in conjunction with habitat projects. Landowners voluntarily open their land to hunting, fishing, and/or wildlife viewing in return for habitat enhancements. The URP, in conjunction with CREP and CRP, has increased the extent and/or protection and enhancement of riparian wetlands and shrubsteppe habitats within the Subbasin.

Washington Conservation Commission

The WSCC supports conservation districts in Washington, promoting conservation stewardship by funding natural resource projects. The WSCC provides basic funding to conservation districts as well as implementation funds, professional engineering grants, and Dairy Program grants and loans to prevent the degradation of surface and ground waters. The Agriculture Fish and Water Program (AFWP) is a collaborative process aimed at voluntary compliance. The AFWP involves negotiating changes to the existing NRCS Field Office Technical Guide and the development of guidelines for irrigation districts to enhance, restore, and protect habitat for endangered fish and wildlife species, and address state water quality needs. This two-pronged approach has developed into two processes, one involving agricultural interests and the second concerning irrigation districts across the state.

Washington Department of Natural Resources (WDNR)

The WDNR manages state land throughout the Subbasin. These lands are generally located in sections 16 and 36 within each township. Larger blocks and scattered tracts occur in the northern portion of the Subbasin and a checkerboard ownership pattern occurs in the Colockum and Quilomene areas. The main goal of the WDNR is to maximize monetary returns from state lands in order to fund schools. The WDNR also enforces and monitors logging practice regulations on private lands.

Multiple Agencies

(This section taken from Kaputa and Woodward 2002)

Salmon Recovery Planning Act (SRPA, ESHB 2496)

The SRPA provides the framework for developing restoration projects. It requires a limiting factors analysis and establishes a funding program for local habitat restoration projects. It also creates the Governor's Salmon Recovery Office. As a result of this bill, an Independent Scientific Panel was created to provide scientific review for salmon recovery projects.

Washington State Growth Management Act

Various provisions of the Washington State Growth Management Act (GMA) require local comprehensive plans to address planning issues of statewide importance. It is a characteristic of GMA that, depending upon the issue, the state purposes for local plans can be either general or very specific. Relative to natural resource lands (mineral, agricultural and forestry lands), and "critical areas" (wetlands and fish and wildlife conservation, frequently flooded, critical aquifer recharge, and geologically hazardous areas), the expression of state interest is clear and specific. These must be designated and "protected" (critical areas) or "conserved" (agriculture, minerals and forestry) by regulation (36.70A.060). Currently, all five counties and the major municipalities in the Subbasin have growth management plans that include provisions for areas along the Columbia River in their respective jurisdictions.

The "Goals, Policies, and Actions," within the plan are the primary directives for land use decision-making and long range planning. They are also the principal directives to county decision-makers and staff relative to what planning and public works actions, studies, and other projects, have to be undertaken during the plan's 20 year horizon in order to address current and future growth and development, and resource issues.

Wild Stock Restoration Initiative (WSRI), ESHB 1309

In 1993, Washington State adopted the WSRI and initiated a commitment to salmonid protection and recovery that has led to more recent salmon recovery legislation. Recently enacted state legislation (1998-1999) designed to guide salmon recovery in the state of Washington includes the SRPA (ESHB 2496), Watershed Planning Act (ESHB 2514), and Salmon Recovery Funding Act (2E2SSB 5595). Stock inventories were the initial commitment of state and tribal fishery managers to the WSRI that complemented and strengthened ongoing programs to protect salmonid stocks and habitats. The Salmon and Steelhead Inventory and Assessment Program (SSHIAP), an integral part of WSRI, is a partnership-based information system that characterizes freshwater and estuary habitat conditions and distribution of salmonid stocks in Washington.

SSHIAP is designed to support regulatory, conservation, and analysis efforts such as Washington State Watershed Analysis, State Salmon Recovery, Habitat Conservation Planning, and EDT.

Local Programs, Plans, and Policies

Local groups involved in fish and wildlife protection within the Subbasin include Conservation Districts, the agricultural community, County government and non-governmental organizations.

Agricultural Community

Private landowners manage the vast majority of shrubsteppe and riparian wetland habitats in the Subbasin. Many landowners protect, enhance, and maintain privately owned/controlled grasslands and riparian habitats through active participation in the USDA's CRP and CREP programs.

Most of the sediment delivered to Douglas and Foster Creeks and their tributaries comes from upland agricultural areas. Agriculturalists apply Best Management Practices (BMPs) to croplands to reduce the amount of soil leaving these areas. The BMPs include upland sediment basins designed to catch sediment; terraces to direct runoff to sediment basins or grassed waterways and filter strips; strip cropping; and direct seeding of crops reducing summer-fallow acres and reducing erosion by 95 percent on those acres. Landowners also control noxious weeds, which severely affect wildlife habitats and populations.

Foster Creek Conservation District (FCCD)

Foster Creek Habitat Conservation Plan (FCHCP)

The FCCD in northern Douglas County is preparing a multi-species HCP (FCHCP) and Draft EIS for privately owned and/or operated agricultural lands in the county. The FCHCP will offer potential coverage to all privately owned or operated agricultural land in Douglas County. Type and ownership of land is comprised of a mix of agricultural and sagebrush-steppe ecosystems.

A Best Management Practices matrix, adaptive management plan, and monitoring and implementation plan are being created, with input from the farming, ranching, and orcharding community, and a technical advisory committee, to analyze all potential agricultural land-use actions for 20 covered species in the FCHCP. The FCHCP will minimize and mitigate the incidental take of threatened and endangered species as a result of typical agricultural activities in Douglas County.

The FCHCP has been in development for the past four years and is currently reaching its final draft form. The final FCHCP is several years from final implementation, but research and analysis have identified land use practices beneficial to wildlife as well as the local agricultural economy. FCHCP development relied on stakeholder input from citizens involved in the ESHB 2514 Watershed Planning and ESHB 2496 Limiting Factors Analysis groups, and planning expertise from NRCS and FSA in conjunction with CRP and EQIP.

Public Utility District No. 1 of Chelan County (Chelan PUD)

Chelan PUD owns and operates the Rocky Reach and Rock Island dams and associated reservoirs and project works. The project was authorized by Congress under Public Law 83-544 and is regulated by the Federal Energy Regulatory Commission under License Numbers 2145 and 943, respectively. The Rocky Reach license is up for renewal in 2006. The Rock Island license is up for renewal in 2029 (CCPUD 2002a,b).

Presently, protection for anadromous salmonids through the Rock Island and Rocky Reach reservoirs is guided by the proposed Anadromous Fish Agreement and Habitat Conservation Plans, Rocky Reach Hydroelectric Project (FERC License No. 2145) and Rock Island Hydroelectric Project (FERC License No. 943) dated March 26, 2002. The plan has an outcome-based approach and is designed to protect spring Chinook salmon, summer/fall Chinook salmon, sockeye salmon, steelhead, and coho salmon (after naturally spawning populations are reestablished) (CCPUD 2002a,b).

Wildlife habitat management along the Rock Island Reservoir has been addressed in the FERC operating license for Rock Island Dam. The FERC document, Revised Exhibit S Fish and Wildlife Plan 1984, lists the actions that Chelan PUD will carry out to mitigate for any potential losses to wildlife or associated habitats with regards to the operation of Rock Island Dam (FERC 1984).

Chelan County PUD has begun the process of obtaining a new license to operate the Rocky Reach Hydroelectric Project. Efforts center on developing a balance between the many resources associated with the Rocky Reach Hydro Project, such as fish and wildlife, water quality, recreation, aesthetics, land use and power production. The final license application and applicant prepared environmental assessment will be submitted to FERC in June 2004 (CCPUD 2004).

Public Utility District No.1 of Douglas County (Douglas PUD)

Douglas PUD owns and operates the Wells Dam and associated reservoir and project works. The project was authorized by the Federal Energy Regulatory Commission under License No. 2149. The FERC license provides the terms and operating conditions for the project. The license is up for renewal in 2012.

Presently, protection for anadromous salmonids through the Wells reservoir is guided by the 1990 Long-term Fisheries Settlement Agreement and proposed Anadromous Fish Agreement and Habitat Conservation Plans, The Wells Hydroelectric Project (FERC License No. 2149), dated March 26, 2002. The plan has an outcome-based approach and is designed to protect spring Chinook salmon, summer/fall Chinook salmon, sockeye salmon, steelhead, and coho salmon (after naturally spawning populations are reestablished). Protection, mitigation, and enhancement measures include operation of adult fish ladders, operation of a highly effective juvenile fish bypass system, operation of supplementation hatchery programs, implementation of a sockeye spawning protection program, and continued funding for predator harassment and control measures (DCPUD 2002).

The Wells Hydroelectric Project wildlife mitigation program is funded by the Douglas County PUD and administered by the Washington Department of Fish and Wildlife. The Wells Wildlife Area consists of six Habitat Management Units with a combined area of over 8,200 acres. Additional land is managed by leases or easements. Development of wildlife habitat and provisions for public wildlife-oriented recreation are features of this program. Additional wildlife mitigation is provided by the Cassimer Bar wildlife area within the boundaries of the Colville Reservation provided as a result of a cooperative program between the Colville Confederated Tribes and Douglas PUD. Douglas PUD's ongoing habitat projects on District owned land include fencing to exclude livestock from riparian areas, shoreline erosion control, new riparian shrub plantings and habitat restoration on disturbed areas (DCPUD 2002).

Public Utility District No. 2 of Grant County (Grant PUD)

Grant PUD owns, operates, and manages the Priest Rapids Project (PRP), which consists of two developments, only one (Wanapum Dam) is included in this subbasin. The project was authorized by Congress under Public Law 83-544 and is regulated by the Federal Energy Regulatory Commission under License No. 2114, which expires on October 31, 2005. The FERC license provides the terms and operating conditions for the project. Requirements related to fish and wildlife include Article 39, which requires that Grant PUD construct, operate, and maintain fish ladders, fish traps, fish hatcheries, or other fish facilities or fish protective devices for the purpose of conserving the fishery resources (Kaputa and Woodward 2002).

Grant PUD is applying for a new 50-yr license for the Project and submitted its Final License application for the Priest Rapids Project to FERC in October 2003. Future fish and wildlife protection, mitigation, and enhancement measures were proposed for the Wanapum Development and Priest Rapids Project. Fish programs are as follows: construction and improvements to fishways; spill; video fish counting; enhanced downsteam bypass; gatewell exclusion screens; predator control; anadromous fish monitoring and evaluation studies; fish hatchery, acclimation, and broodstock facilities; habitat mitigation fund; spawning habitat enhancements; and other fish protection, restoration, enhancement and feasibility programs. Wildlife programs include a land acquisition fund, protection from transmission lines, plant research and monitoring, fire suppression, avian perch / roosting and nesting enhancements, and other management, enhancement, and conservation programs. The annual and operating cost for the fish and wildlife programs is estimated at $41,782,362, and $288,500, respectively, with total capital expenditures estimated at $119,889,832 and $10,700. More detailed information on the PRP is available in the Priest Rapids Project License Application FERC No. 2114 (GCPUD 2003a).

The Nature Conservancy

The Nature Conservancy is a nation-wide non-profit agency with the goal of protecting biological diversity. Protection and restoration of healthy shrubsteppe ecosystems is a priority for TNC of Washington. Some of the largest and highest quality examples of this habitat type remain in the North Central portion of the state. The Conservancy has been purchasing land within Grant and Douglas County to help meet this conservation goal. TNC began acquiring property in Douglas County's Jameson Lake area in 1999 when it purchased what has become the 3,500-acre Moses Coulee Preserve. Since then TNC has purchased 16,000 acres along McCartney Creek, and a conservation easement on 2,800 acres near the Sagebrush Flat Wildlife Area. The Nature Conservancy also has a management agreement on 900 acres immediately east of Jameson Lake. In the northern Grant County portion of the complex, TNC owns approximately 5,500 acres in the Beezley Hills, and acquired an additional 1,400 acres in September of 2003.

All TNC land in the Moses Coulee area is managed for the protection and restoration of the shrubsteppe ecosystem, with special focus on a suite of shrubsteppe community types, seeps and springs, stream and riparian systems, cliffs and talus slopes, pygmy rabbits, and sage grouse.

Upper Columbia Salmon Recovery Board (UCSRB)

The Upper Columbia Salmon Recovery Board (UCSRB), a regional cooperative comprised of Chelan, Douglas, and Okanogan Counties, the Yakama Nation, and the Colville Tribes, formed in early 1999 to address regional fish and wildlife recovery issues. The UCSRB is currently developing a "Coordinated Regional Strategy" that will integrate federal, state, and local salmon recovery planning and project implementation.

Yakima Training Center, DOD (YTC)

The United States Department of the Army owns and occupies 500 sq. mi. (323,651 acres) in Kittitas and Yakima counties. Acquired in 1942, the YTC is bounded by I 82 on the east, the Columbia River to the west, Boylston Mountains to the north and the Yakima Ridge to the south. The Army's primary use of the installation is for state-of-the-art live fire training for infantry, tanks, and helicopters. This area also represents one of the two largest unaltered portions of shrub-steppe habitats in Washington, with 27 plant, 37 wildlife and 2 fish species listed as sensitive by the state. Over the last 20 years, the Army has increased its role as land steward of this diminishing shrubsteppe habitat. YTC biologists manage the natural resources of the military installation in coordination with the Army's primary role of troop training. The installation's Cultural and Natural Resource Management Plan is an integrated comprehensive five-year plan that details management strategies undertaken for cultural and natural resources on YTC. The training center must comply with the Endangered Species Act, the Clean Water Act and other federal laws. Erosion, water pollution, denuded vegetation and compacted soil are a few of the problems the training center is attempting to tackle with its Integrated Area 5-Year Management Plan that was adopted in 1998. Some of the anticipated projects included reseeding, road realignments, and closures and stream crossing improvements (Fast and Berg 2001).

5.1.4 Fish and Wildlife Conservation, Restoration, and Research Projects

The section summarizes the fish and wildife restoration and conservation activities that have occurred over the last five years, or will be implemented in the near future. These activities are compared to the assessment to identify the gaps between actions already taken or underway, and actions that are needed to achieve desired results. Projects are grouped by assessment unit: wildlife – shrubsteppe, eastside (interior) riparian, herbaceous wetland, and agriculture; fish – Columbia River, small tributaries, and projects affecting both the Columbia River and its tributaries. See Table 42 - Table 48.

Wildlife

Shrubsteppe Assessment Unit

Table 42 Ongoing projects within the shrubsteppe assessment unit related to conservation, restoration, and research activities

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Colville Tribes & WDFW		2001	Sharp-tailed Grouse Restoration	**Project Description:** Established a 7,000 acre block of high quality grasslands and embarked on a project to collect habitat (e g , lek surveys) and biological information on sharp-tailed grouse on the Colville Reservation **Rationale & Results:** To develop a Sharp-tailed Grouse Restoration Plan and protect a core population on the Reservation
FCCD, Ferry County Washington State University Cooperative Extension office, WDFW, & TNC		2002-2003	Biological Weed Control	**Project Description:** Insects were released in Douglas county on private land to control the invasion of noxious weed species: Stem-boring weevil (Mecinus janthinus) to control Dalmatian toadflax; Gymnetron tertrum to suppress mullein; Larinus minutus for diffuse knapweed; and Rhinocyllus conicus to suppress Canada thistle **Rationale & Results:** Protect and restore native ecosystems for threatened and endangered species by controlling the invasion of noxious weeds
WDFW	CCPUD	1999-2002	Mule Deer Winter Habitat Use Study	**Project Description:** Provided information on winter habitat use by mule deer **Rationale & Results:** To enhance winter habitat use areas

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW		Completed in 1999	Shrubsteppe Bird Response to Habitat and Landscape Variables in Eastern WA	**Project Description:** Studied bird responses to shrubsteppe habitat and landscape variables in Eastern Washington. **Rationale & Results:** Results suggest that fragmentation of shrubsteppe and the pattern of agricultural conversion among soil types have had detrimental effects on numerous shrubsteppe species.
WDFW		Ongoing	Sage and Sharp-tailed Grouse Lek Surveys	**Project Description:** Annual counts of bird attendance on leks and survey for new leks. **Rationale & Results:** Document population trend.
WDFW & WSU			Pygmy rabbit habitat evaluation	**Project Description:** **Rationale & Results:**
WDFW, WSU, & TNC		Ongoing	Pygmy Rabbit Burrow Survey	**Project Description:** Locate new burrows and used as index for population trend. **Rationale & Results:** Ongoing project.
WDFW, WSU, BPA, & DNR,			Sagebrush Flat Unit Vegetation Analysis: Pygmy Rabbit	**Project Description:** Examined vegetation differences between grazed and ungrazed areas. **Rationale & Results:**
WDFW		2003-2004	Wildlife communities in shrubsteppe and Conservation Reserve Program lands in eastern Washington	**Project Description:** Compare wildlife communities in CRP fields and nearby native shrubsteppe **Rationale & Results:** Study is not complete.
WDFW			Parasitism by Brown-Headed Cowbirds in the Shrubsteppe of Eastern Washington	**Project Description:** Studied parasitism by brown-headed cowbirds. **Rationale & Results:** Only the Brewer's Sparrow, Sage Sparrow, and Vesper Sparrow showed evidence of parasitism. Overall parasitism rates were lower than those reported for other bird communities in fragmented landscapes and for other bird communities in shrubsteppe. Low parasitism levels (<10 %) in the study area partly resulted from arrival of cowbirds after initiation of first nests by hosts.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW		Ongoing	Changes in the Distribution and Abundance of Columbian Sharp-Tailed Grouse in Washington	**Project Description:** Document distribution and abundance of Columbian sharp-tailed grouse. **Rationale & Results:** Historic and recent declines of sharp-tailed grouse appear linked to dramatic declines in quantity and quality of native habitat.
WDFW		Ongoing	Distribution and Abundance of Sage Grouse in Washington	**Project Description:** Document distribution and abundance of sage grouse. **Rationale & Results:** The decline in distribution has been dramatic; 71% of 69 lek complexes documented since 1960 are currently vacant. Historic and recent declines of greater sage-grouse are linked to conversion of native habitat for production of crops and degradation of the remaining native habitat.
WDFW		Completed in 2002	Predation on Real and Artificial Nests in Shrubsteppe Landscapes Fragmented by Agriculture	**Project Description:** Artificial nests were monitored by cameras to examine relative effects of fragmentation, distance to edge, and vegetation cover on nest predation rates and to identify predators of shrubsteppe nesting passerines and grouse. **Rationale & Results:** Fragmentation had a strong influence on predation rates for artificial nests, with nests in fragmented landscapes about 9 times more likely to be depredated as those in continuous landscapes.

Riparian Assessment Unit

Table 43 Ongoing projects within the Riparian Wetland assessment unit related to conservation, restoration, and research activities in the UMM Subbasin, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		1975–ongoing	Wildlife Studies: Bald Eagles, wood ducks, and geese.	**Project Description:** Study perch site use, winter abundance, and effects of recreational use on bald eagles in eastern WA. Annual wood duck & goose nesting (rocky reach & rock Island) surveys. **Rationale & Results:**

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USFWS & Colville Tribes			Morning Dove & Waterfowl Surveys	**Project Description:** Conducted every fall (funding permitting) on the ponds & lakes of the Plateau (western Colville Reservation) **Rationale & Results:** Used to track species occurrences and to set waterfowl hunting dates and harvest.

Herbaceous Wetland Assessment Unit

Table 44 Ongoing projects within the Herbaceous Wetland assessment unit related to conservation, restoration, and research activities in the UMM Subbasin, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
No information available				

Agriculture Assessment Unit

Table 45 Ongoing projects within the Agriculture assessment unit related to conservation, restoration, and research activities in the UMM Subbasin, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
WDFW		2003-2004	Wildlife communities in shrubsteppe and Conservation Reserve Program lands in eastern Washington	**Project Description:** Compare wildlife communities in CRP fields and nearby native shrubsteppe **Rationale & Results:** Study is not complete.
WDFW		Completed in 2002	Predation on Real and Artificial Nests in Shrubsteppe Landscapes Fragmented by Agriculture	**Project Description:** Artificial nests were monitored by cameras to examine relative effects of fragmentation, distance to edge, and vegetation cover on nest predation rates and to identify predators of shrubsteppe nesting passerines and grouse. **Rationale & Results:** Fragmentation had a strong influence on predation rates for artificial nests, with nests in fragmented landscapes about 9 times more likely to be depredated as those in continuous landscapes.

Fish

Columbia River Assessment Unit

Table 46 Ongoing projects related to conservation, restoration, and research activities in the UMM Columbia River, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		1933-2028	Rock Island Hydro Project	**Project Description:** Tested turbine intake screens and shallow spills, Installed notched spillgates, fish ladders, and prototype flow deflector, & monitored TDG **Rationale & Results:** Hydro project does not delay return trip of adult salmon to spawning grounds
CCPUD		1985-2001	Rocky Reach Fish Passage/Guidance	**Project Description:** Studied feasibility of using diversion screens to guide fish away from turbines and around dam **Rationale & Results:** Passage improvements achieved with surface and gatewell collectors
CCPUD		2000	Pacific Lamprey	**Project Description:** Summarized biological and dam passage info on Pacific Lamprey **Rationale & Results:** Status report for Pacific Lamprey in the Mid-Columbia
CCPUD		2000	Rocky Reach Fish Species Assemblages	**Project Description:** Reviewed & summarized existing info on fish species assemblages and effects of resident predators **Rationale & Results:** Report (Bioanalysts 2000b)
CCPUD		1997-2000	Gas Bubble Trauma - Rocky Reach Dam	**Project Description:** Monitored GBT Rationale & Results:
CCCPUD		1994-99	Resident Fish Projects	**Project Description:** Tracked movements of northern pikeminnow up- & down-stream of Rock Island and Rocky Reach **Rationale & Results:** Determined where fish congregate & reduced their size & numbers

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD		1997	Turbine Survival Testing - Rock Island Dam	**Project Description:** Estimated survival of hatchery Chinook salmon passing through turbines **Rationale & Results:** Provided comparison of salmonids fate in different turbine types to develop mitigations strategies
CCPUD		1994-96	Turbine Survival Testing - Rocky Reach Dam	**Project Description:** Assessed fish survival and condition differences between new and old turbine blade designs **Rationale & Results:** Overall average fish survival the same between turbines; 48 hour Survival probabilities varied
CCPUD		1995 - Ongoing	Gas Bubble Trauma - Rock Island Dam	**Project Description:** Monitored GBT **Rationale & Results:**
CCPUD		1988	Rock Island Fish Passage/Guidance	**Project Description:** Tested efficiency of fish guidance equipment & installed notched spill gates **Rationale & Results:** Most efficient method of fish passage was spill
CCPUD		1985-Ongoing	Rock Island Trap	**Project Description:** Smolt-monitoring and PIT tagging programs **Rationale & Results:** To compare and evaluate annual migration timing, magnitude, & travel time of juvenile salmonids
CCPUD		1982 – Ongoing	Total Dissolved Gas Monitoring	**Project Description:** TDG monitoring at Rocky Reach and Rock Island dams **Rationale & Results:**
CCPUD			Fish Behavioral Studies	**Project Description:** Used acoustic tags to track fish 3-dimensionally (within 1 meter of actual location) **Rationale & Results:** Gained better understanding of fish distribution & behavior at Rocky Reach & Rock Island dams & more efficient bypass systems

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD & DCPUD		1998-2001	Survival Studies	**Project Description:** Used PIT and radio tags to estimate survival of hatchery and run-of-river Chinook & steelhead at Rock Island & Rocky Reach **Rationale & Results:**
CCPUD, DCPUD, & GCPUD		1990s	Bull Trout Movement/Migration	**Project Description:** Tracked movements & migrations of bull trout from Priest Rapids to Chief Joseph tailraces & rearing basins using radio telemetry **Rationale & Results:** Correlated movements & distribution with operations of PUD hydo projects
CCPUD & WDFW		2000	Gas Abatement at Rock Island	**Project Description:** Installed & tested prototype spill deflector ramp **Rationale & Results:** Safe for passage Moderately effective in gas abatement Decided to reduce submergence of prototype
Colville Tribes & Battelle			Assessment of Potential Fall Chinook Spawning Habitat in the Upper Columbia River	**Project Description:** Estimated location and quantity of potential spawning habitat and determined redd capacity of upper section of Chief Joseph Reservoir (Grand Coulee Dam tailrace [rkm 956] downstream to Coyote Creek [rkm 928]) **Rationale & Results:** Report (Hanrahan et al. 2001)
DCPUD	DCPUD		Wells Hydroelectric Project Fish Counts	**Project Description:** Salmon & Steelhead counts taken 24 hours a day, May 1st to Nov 15th, at Wells Dam fish ladders **Rationale & Results:**
DNR	Aquatic Lands Enhancement Account $200,000 (ALEA share)	1995-97	Rocky Reach Trailway	**Project Description:** Developed 1st phase of multi-use paved trail **Rationale & Results:** Developed half mile trail from Lincoln Rock State Park to Rocky Reach Dam

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
DNR	Aquatic Lands Enhancement Account $72,477 (ALEA share)	1991-93	Porter's Pond Shoreline Trail	**Project Description:** Developed 2,600 ft pedestrian-bicycle trail, trail head, parking, & interpretive points **Rationale & Results:** Completed Apple Capital Loop along Wenatchee & East Wenatchee, Columbia River shoreline
DNR	Aquatic Lands Enhancement Account $29,120 (ALEA share)	1991-93	Porter's Pond Interpretive Area	**Project Description:** Created interpretive elements along trail / viewpoints **Rationale & Results:** Promoted awareness and appreciation
DNR	Aquatic Lands Enhancement Account, $31,673	1987-89	Brewster Waterfront Pathway	**Project Description:** Developed a pedestrian path along 2,300 ft of Lake Pateros shoreline **Rationale & Results:** New pedestrian pathway
Ecology	Environmental Assessment	2001	Chinet Intake Toxicity Investigation	**Project Description:** Conducted Daphnia pulex (water flea) acute bioassays on samples of Columbia River intake water from Chinet Co , Wenatchee **Rationale & Results:** No evidence of toxicity
GCPUD			Wanapum Dam	**Project Description:** Provided spill, installed flow deflectors, monitored TDG, alleviated predation, and operated & maintained fishways **Rationale & Results:** Improved fish passage, and reduced predation & TDG levels
GCPUD			Priest Rapids Hydroelectric Project, FERC No P-2114, Draft Application for New License (GCPUD 2003a)	**Project Description:** Identified resource issues & impacts in project vicinity & developed potential solutions and protective measures **Rationale & Results:** Multiple reports on natural resources

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
USACOE			Preliminary Investigation of Fish Passage Alternatives	**Project Description:** Reconnaissance level evaluation of possible fish passage concepts at Chief Joseph Dam **Rationale & Results:** Report (Corps 1999)

Small Tributaries Assessment Unit

Table 47 Ongoing projects related to sonservation, restoration, and research activities in tributaries to the UMM Subbasin, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
Ecology	Environmental Assessment	2002	Stream Biological Monitoring: Foster Creek at Highway 17	**Project Description:** Collected freshwater invertebrates and monitored other site conditions Rationale & Results: Indicates health of WA streams and helps detect degradation because of forest and agricultural practices, urbanization, or other controllable sources of impact
Ecology	Environmental Assessment	1993-96	Stream Biological Monitoring: Douglas Creek at Alstown	**Project Description:** Collected freshwater invertebrates and monitored other site conditions Rationale & Results: Indicated health of WA streams and helped detect degradation because of forest and agricultural practices, urbanization, or other controllable sources of impact
Ecology	EILS	1994 Ongoing since 1991-diff waterbodies ea Yr - Only "94" had area near/in UMM	WSPMP 1993 Pesticides in Surface Water	**Project Description:** The WSRP analyzed surface water for pesticide residues **Rationale & Results:** Provided info on pesticide distribution & pattern changes over time

Projects affecting both the Columbia River and Tributaries

Table 48 Ongoing projects affecting both the Columbia River and Tributaries related to conservation, restoration, and research activities in the UMM Subbasin, WA.

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
CCPUD, DCPUD, GCPUD, & Don Chapman Consultants		1990s	Status Reports for Anadromous Salmon	**Project Description:** Prepared status reports for summer steelhead, sockeye & summer, fall, & spring Chinook salmon **Rationale & Results:** Reports on biology, ecology, & status of each species
DNR & Douglas County	DNR Aquatic Lands Enhancement Account $7,737 (ALEA share)	1993-95	Countywide Shoreline Access Plan	**Project Description:** Douglas County survey, inventoried, and prioritized sites for future acquisition as public access **Rationale & Results:** Results in County Shoreline Plan & Handbook
Ecology	1997-98 EILS-IFU, 1998-99 Environmental Assessment	1998-99 & 1997-98,	Measured Streamflow	**Project Description:** Measured streamflow **Rationale & Results:** Measured flows used to create rating curves in support of Ambient Streamflow water quality monitoring
Ecology	EILS	Fall, 1998	Central Columbia Basin GWMA - Nitrate Characterization Study	**Project Description:** Characterized the concentration & distribution of nitrate in groundwater in Grant County **Rationale & Results:** USGS Water Resources Invest Rpt 99-4288
Ecology	EILS / Environmental Assessment	Before 1959-Ongoing	Statewide River and Stream Ambient Monitoring	**Project Description:** Collected water quality data monthly Since 1988, at 82 stations statewide; three in UMM (near Entiat, Wenatchee, & Pateros, WA) **Rationale & Results:** Measured thirteen constituents (since 1988)
WDFW (Operating Agency)	DCPUD, Total operating costs exceed $700,000 annually		Wells Hatchery	**Project Description:** To enhance summer/fall Chinook and steelhead stocks; release 1,300,000 annually in Columbia River and tributaries above Wells Dam **Rationale & Results:**

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results
			Mid-Columbia Coho Feasibility Reintroduction Study #9604000 (BPA et al. 2002)	**Project Description:** Determining feasibility of reestablishing a naturally spawning coho population in Mid-Col tribs (esp Wenatchee & Methow subbasins) and Columbia River (migration, etc) **Rationale & Results:**

6 Management Plan

6.1.1 Introduction

Emphasis in this management plan is placed on selected focal habitats and fish and wildlife species described in the inventory and assessment. Management goals, objectives, and strategies will aide subbasin planners and state salmon recovery personnel in the conservation and restoration of important habitat and focal species. It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. It is clear from the inventory and assessment that reliable quantification of most subbasin level impacts is lacking; however, many anthropogenic changes have occurred and will continue to occur in the future and impact the focal habitats: riparian wetlands, shrub-steppe, herbaceous wetland habitats, Columbia River, and small tributaries. Recommendations are made within this presumptive framework.

While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the greatest degree of existing impacts within the subbasin. In particular, the majority of shrub-steppe and herbaceous and riparian wetlands habitats fall within the low or no protection status categories. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (e.g., USFS adjustments to grazing management).

The management plan is made up of six components: 1) the vision for the subbasin; 2) the working hypothesis; 3) subbasin goals, objectives, and strategies; 4) monitoring, evaluation, and adaptive management; 5) comprehensive plans; and 6) research. Since the biological objectives are linked to the working hypotheses, we have inserted them here also for better clarity.

One of the primary interests of this subbasin plan is to identify management actions that promote compliance of the ESA and the CWA. None of the recommended management strategies are intended nor envisioned to compromise or violate any federal, state, or local laws or regulations. Rather, the management strategies are intended to provide local solutions that will enhance the intent and benefit of these laws and regulations. This subbasin plan complies with the intent of the ESA and the CWA primarily through the Mid Columbia HCP, FERC license mitigation programs, and other local fish and wildlife efforts in a region wide context.

6.1.2 Vision for the Subbasin

Natural habitats exist with sufficient quantity, quality, and linkages to perpetuate existing native fish and wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated fish and wildlife species are restored within the subbasin.

6.1.3 Working Hypothesis

The working hypotheses for focal habitat types are based on the factors that affect/limit focal habitats (the term, “factors that affect habitat” is synonymous with “limiting factors” for fish and wildlife species). Ecoregion and subbasin level working hypotheses are statements that assist subbasin planners and their communities to clearly articulate a program aimed at addressing the most pressing needs in a given area. The hypothesis is based on the limiting factors described in the Assessment and defines the relationship between limiting factors and the goals, objectives and strategies in the Managent Plan. These relationships are tested through implementation, followed by monitoring and evaluation. Ultimately, adaptive management is used to respond to the outcomes of these “tests” of “working hypotheses.” Hypotheses for subbasin focal habitat types are summarized below.

6.1.4 Subbasin Recovery Goals, Objectives, and Strategies

Biological Objectives

Biological objectives describe physical and biological changes within the subbasin needed to achieve the vision and address factors affecting focal habitats. Biological objectives for all Ecoregion subbasins are habitat based and describe priority areas and environmental conditions needed to achieve functional focal habitat types. Where possible, biological objectives are empirically measurable and based on an explicit scientific rationale (the working hypothesis). Biological objectives are:

- Consistent with subbasin-level visions and strategies
- Developed from a group of potential objectives based on the subbasin assessment and resulting working hypotheses
- Realistic and attainable within the subbasin
- Consistent with legal rights and obligations of fish and wildlife agencies and tribes with jurisdiction over fish and wildlife in the subbasin, and agreed upon by co-managers in the subbasin
- Complementary to programs of tribal, state and federal land or water quality management agencies in the subbasin
- Quantitative and have measurable outcomes where practical

Strategies

Strategies are sets of actions to accomplish the biological objectives. In developing strategies, planners took into account not only the desired outcomes, but also the physical and biological realities expressed in the working hypothesis. Strategies are not projects but instead are the guidance for the development of projects as part of the implementation plan.

Terrestrial/Wildlife

Shrubsteppe

Goal: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrubsteppe and steppe/grassland-dominated shrubsteppe toward conditions identified in the Recommended Future Conditions in the Assessment section of this document.

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of shrubsteppe by the year 2008

Strategy:

- Select and implement methodology, alternative to IBIS or GAP, to accurately characterize shrubsteppe habitat quantity and quality in the UMM Subbasin

Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and other conservation measures to sustain focal species populations and habitats by 2010

Strategies:

- Use federal, state, tribal, and local government programs, such as USDA "Farm Bill" programs, to conserve shrubsteppe habitat
- Achieve permanent protection of shrubsteppe through acquisition, conservation easement, cooperative agreements, etc.
- Emphasize conservation of large blocks and connectivity of high quality shrubsteppe habitat
- Promote local planning and zoning to maintain or enhance large blocks of habitat

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing shrubsteppe

Strategies:

- Promote and support implementation of the Foster Creek Habitat Conservation Plan (currently in development)
- Implement habitat stewardship projects with private landowners
- Develop fire management protocols (e.g., protection and prescribed burning) to produce desired shrubsteppe habitat conditions
- Implement existing plans (e.g., Wenatchee National Forest plan, Bureau of Land Management Spokane Resource Management Plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plans, Colville Tribes Integrated Resource Management Plan)
- Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan (e.g., Moses Coulee Cooperative Weed Management Area)
- Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1: Determine population status of sage thrasher by 2008

Strategies:

- Select survey protocol and measure abundance of focal species
- Select survey protocol and measure diversity and richness of species assemblages within shrubsteppe

Biological Objective 2: Within the framework of the sage thrasher population status determination and existing sharp-tailed grouse and sage grouse population determinations, inventory other shrubsteppe obligate populations to test assumption of the umbrella species concept for conservation of other shrubsteppe obligates

Strategy:

- Implement federal, state, and tribal management plans, other conservation plans, or recovery plans to conserve the focal species

Biological Objective 3: Maintain and enhance pygmy rabbit populations consistent with state and federal management and recovery plans

Strategy:

- Implement federal, state, and tribal management plans, other conservation plans, or recovery plans to conserve the focal species

Eastside (Interior) Riparian Wetlands

Goal: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions identified in Recommended Future Conditions in the Assessment section of this document

Habitat Objective 1: Determine the necessary amount, quality, and connectivity of riparian wetlands by the year 2008

Strategy:

- Select and implement methodology, alternative to IBIS or GAP, to accurately characterize riparian wetlands habitats in the UMM Subbasin

Habitat Objective 2: Based on findings of Habitat Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010

Strategies:

- Use federal, state, tribal, and local government programs, to conserve, enhance, and/or restore riparian wetlands habitat
- Achieve permanent protection of riparian wetlands through acquisition, conservation easement, cooperative agreements, etc.
- Emphasize conservation connectivity of high quality riparian wetlands habitat
- Promote local planning and zoning to maintain or enhance riparian wetlands habitat

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands

Strategies:

- Promote and support implementation of the Foster Creek Habitat Conservation Plan (currently in development)
- Implement habitat stewardship projects with private landowners
- Implement existing plans (e.g., Wenatchee National Forest plan, Bureau of Land Management Spokane Resource Management Plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plans, Colville Tribes Integrated Resource Management Plan)
- Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan (e.g., Moses Coulee Cooperative Weed Management Area)
- Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1: Determine population status of beaver, willow flycatcher, Lewis' woodpecker by 2008

Strategies:

- Select survey protocol and measure abundance of focal species
- Select survey protocol and measure diversity and richness of species assemblages within riparian wetland habitats

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates

Strategy:

- Implement federal, state, tribal management, other conservation plans, or recovery plans to conserve the focal species

Biological Objective 3: Based on findings of Biological Objective 1 and Habitat Objective 2, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives

Strategies:

- Protect, and where necessary restore, habitat to support beaver
- Reintroduce beaver into suitable habitat where natural recolonization may not occur
- Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2

Herbaceous Wetlands

Goal: Provide sufficient quantity and quality herbaceous wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing herbaceous wetland habitats toward conditions identified in the Recommended Future Conditions in the Assessment section of this document

Habitat Objective 1: Determine the necessary amount, quality, and connectivity of herbaceous wetlands by the year 2008

Strategy:

- Select and implement methodology, alternative to IBIS or GAP, to accurately characterize riparian wetlands habitats in the UMM Subbasin

Habitat Objective 2: Based on findings of Habitat Objective 1, provide biological and social conservation measures to sustain focal species populations and habitats by 2010

Strategies:

- Use federal, state, tribal, and local government programs, to conserve herbaceous wetlands habitat
- Achieve permanent protection of riparian wetlands through acquisition, conservation easement, cooperative agreements, etc.
- Emphasize conservation connectivity of high quality herbaceous wetland habitat
- Promote local planning and zoning to maintain or enhance herbaceous wetland habitat

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing herbaceous wetlands

Strategies:

- Promote and support implementation of the Foster Creek Habitat Conservation Plan (currently in development)
- Implement habitat stewardship projects with private landowners
- Implement existing plans (e.g., Wenatchee National Forest plan, Bureau of Land Management Spokane Resource Management Plan, Chelan County Watershed Mgt Plan, WDFW Wildlife Area Management Plans, Colville Tribes Integrated Resource Management Plan)
- Develop and implement a coordinated, cross-jurisdictional comprehensive weed control management plan (e.g., Moses Coulee Cooperative Weed Management Area)
- Develop and implement a coordinated, cross-jurisdictional road management plan

Biological Objective 1: Determine population status of red-winged blackbird in the UMM by 2008

Strategies:

- Select survey protocol and measure abundance of focal species

- Select survey protocol and measure diversity and richness of species assemblages within riparian wetland habitats

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other herbaceous wetland obligate populations to test assumption of the umbrella species concept for conservation of other herbaceous wetland obligates.

Strategy:

- Implement federal, state, and tribal management and recovery plans

Aquatic/Fish

Columbia River

Goal: Use NPCC fish and wildlife mitigation programs to compliment the implementation of the Mid Columbia HCP, FERC license mitigation programs, and other local fish and wildlife efforts in a region wide context

Biological Objective 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distribution across the species' native range, so that the species can eventually be delisted

Strategies:

- Maintain and enhance current distribution of bull trout within the UMM of the Columbia River
- Maintain stable or increasing trends in abundance of bull trout
- Restore and maintain suitable habitat conditions for overwintering, foraging, and migration for bull trout

Biological Objective 2: Reduce threats to the long-term persistence of bull trout populations and their habitat, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms

Strategies:

- Reduce impacts from residential and recreational development

Biological Objective 3: Improve current knowledge base on bull trout throughout the Upper Middle Mainstem of the Columbia River Watershed

Strategies:

- Complete a bull trout fish use study in the Upper Middle Mainstem of the Columbia River
- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River

Biological Objective 4: Reduce threats to the long-term persistence of populations and their habitat, ensuring the security of multiple interacting groups of white sturgeon, and providing habitat and access to conditions that allow for the expression of various life history forms

Strategies:

- Determine the location and degree of spawning throughout the Columbia River from Wanapum Dam to Chief Joesph Dam
- Determine effects of passage through the hydroelectric projects and how the project areas may be modify to facilitate more success
- Determine the degree of predation by native and non-native species on larval sturgeon
- Determine how flows affect existing spawning habitat and rearing success

Biological Objective 5: Improve current knowledge base on white sturgeon throughout the Upper Middle Mainstem of the Columbia River Watershed

Strategies:

- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River
- Determine the effects of a supplementation progam on thecurrent population

Biological Objective 6: Reduce threats to the long-term persistence of populations and their habitat, ensuring the security of multiple interacting groups of Pacific lamprey, and providing habitat and access to conditions that allow for the expression of various life history forms

Strategies:

- Determine effects of passage through the hydroelectric projects and how the project areas may be modify to facilitate more success
- Determine migration periods of Pacific lamprey through the system and in to the tributaries
- Determine effects of hydro-electirc project on all life stages

Biological Objective 7: Improve current knowledge base on Pacific lamprey throughout the Upper Middle Mainstem of the Columbia River Watershed

Strategies:

- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River
- Improve enumeration of lamprey at the hydro-electric projects
- Conduct adult telemetry studies to determine population distribution

Small Tributary Assessment

To accommodate the numerous small streams within the UMM Subbasin, the goals, objectives, and strategies have been set-up in table format and grouped alphabetically by tributary (Table 49 - Table 64). Each listed objective includes a description of the task, rationale, outcome, and uncertainty of the project.

Brushy Creek

Table 49 Management plan recommendations for Brushy Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

Colockum Creek

Table 50 Management plan recommendations for Colockum Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Improve water flows	Work with existing water rights holders to conserve water or acquire rights	Goal to restore year-round flows	This would surely increase fish productivity; Maybe some can be convinced to sell their water rights thus allowing a minimum flow for fish in Reach 2	Highly unlikely that all landowners would sell their water rights
Eliminate obstructions to adult steelhead and Chinook migration	Locate and remove obstructions to fish migration	Allow access to spawning steelhead and salmon	Increase of habitat and likely the population	Landowner cooperation is unknown
Reduce the input of fine sediments	Change land use practices in the upper watershed	Reduce silt input will allow the creek substrate to eventually flush out some of silt currently present thus increase productivity of the creek	Increase in ground cover and controlled overland flow	This would require a change in agricultural practices That may or may not be acceptable to the public

Foster Creek

Table 51 Management plan recommendations for Foster Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Restore Riparian Vegetation	Plant and nurture native vegetation along stream banks after channel work to reduce erosion and head-cutting	This would provide the shade and organic materials needed for a viable aquatic ecosystem	This would require cooperation with the landowners coupled with conservation programs This will also assist with wildlife habitat enhancement of riparian areas	Very likely if project funding can be secured, local landowner interest is high

Objective	Task	Rationale	Outcome	Uncertainty
Restore natural channel condition and diversity	Continue implementation of erosion control structures and stream bank restoration	Restore natural habitat conditions needed by resident species	This would require cooperation with the landowners coupled with conservation programs	Very likely if project funding can be secured, local landowner interest is high
Augment surface water flows	Implement groundwater storage projects	Additional groundwater supplies supplement surface water flows	Assessment of project potential has occurred under ESHB 2514, implementation is dependent on funding	Very likely if project funding can be secured, local landowner interest is high
Reduce the input of fine sediments	Implement agricultural best management practices in the upper watershed and other soil conservation programs	Reduce silt input will allow the creek substrate to eventually flush out some of silt currently present thus increase productivity of the creek	This would require cooperation with the landowners coupled with landonwers coupled with conservation programs	Vey likely if project funding can be secured, local landowner interest is high

Johnson Creek

Table 52 Management plan recommendations for Johnson Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted	Funding and low prioritization in a region-wide context
Restore Riparian Vegetation	Plant and nurture native vegetation along stream banks	This would provide the shade and organic materials needed for a viable aquatic ecosystem	Unknown This would require gaining the landowners cooperation, conservation easements or purchasing the land out right This will also assist with wildlife enhancement habitat of riparian areas	Landowner cooperation is unknown
Restore natural Channel condition and diversity	This would require planning and implementation by a fluvial geo-morphologist	Restore natural habitat conditions needed by salmon and steelhead	Unknown This would require gaining the landowners cooperation, conservation easements or purchasing the land out right	Landowner cooperation is unknown
Reduce the input of fine sediments	Change land use practices in the upper watershed	Reduce silt input will allow the stream substrate to eventually flush out some of silt currently present thus increase productivity of the stream	Unknown This would require gaining the landowners cooperation, conservation easements or purchasing the land out right	Landowner cooperation is unknown

Moses Coulee (Douglas and McCarteney Creeks)

Table 53 Management plan recommendations for Moses Coulee, WA.

Objective	Task	Rational	Outcome	Uncertainty
Restore Riparian Vegetation	Plant and nurture native vegetation along stream banks after channel work to reduce erosion and head-cutting	This would provide the shade and organic materials needed for a viable aquatic ecosystem	This would require cooperation with the landowners coupled with conservation programs This will also assist with wildlife enhancement habitat of riparian areas	Very likely if project funding can be secured, local landowner interest is high
Restore natural channel condition and diversity	Continue implementation of erosion control structures and stream bank restoration	Restore natural habitat conditions needed by resident species	This would require cooperation with the landowners coupled with conservation programs	Very likely if project funding can be secured, local landowner interest is high
Augment surface water flows	Implement groundwater storage projects	Additional groundwater supplies supplement surface water flows	Assessment of project potential has occurred under ESHB 2514, implementation is dependent on funding	Very likely if project funding can be secured, local landowner interest is high
Reduce the input of fine sediments	Implement agricultural best management practices in the upper watershed and other soil conservation programs	Reduce silt input will allow the stream substrate to eventually flush out some of silt currently present thus increase productivity of the stream	This would require cooperation with the landowners coupled with conservation programs	Very likely if project funding can be secured, local landowner interest is high

Quilomene Creek

Table 54 Management plan recommendations for Quilomene Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

Rock Island Creek

Table 55 Management plan recommendations for Rock Island Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Restore Riparian Vegetation	Plant and nurture native vegetation along stream banks to reduce erosion and enhance wildlife habitat	This would provide the shade and organic materials needed for a viable aquatic ecosystem	This would require cooperation with the landowners coupled with conservation programs This will also assist with wildlife habitat enhancement of riparian areas	Likely if project funding can be secured, and cooperation with local landowners

Sand Canyon Creek

Table 56 Management plan recommendations for Sand Canyon Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Restore Riparian Vegetation	Plant and nurture native vegetation along stream banks to reduce erosion and enhance wildlife habitat	This would provide the shade and organic materials needed for a viable aquatic ecosystem	This would require cooperation with the landowners coupled with conservation programs This will also assist with wildlife habitat enhancement of riparian areas	Likely if project funding can be secured, and cooperation with local landowners
Reduce sedimentation from flood events	Create sediment catch basin and expand riparian area in reach one	During storm events Sand Canyon is a conduit of stormwater and sediment from the urban and agricultural areas	Enhanced riparian area and educational center near existing County facilities	Funding and full development of project has been a low priority in the region

Sand Hollow Wasteway

Table 57 Management plan recommendations for Sand Hollow Wasteway, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

Skookumchuck Creek

Table 58 Management plan recommendations for Skookumchuck Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat to riparian areas	Funding and low prioritization in a region-wide context

Squilchuck Creek

Table 59 Management plan recommendations for Squilchuck Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of entire watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on parts of the watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context
Eliminate obstructions to adult steelhead and Chinook migration:	Provide fish passage at the South Wenatchee Avenue culvert and other identified barriers (Harza/Bioanalysts 2000)	Allow access to spawning steelhead and salmon and reestablishes connectivity with to the Columbia River	Will provide passage to an unknown amount of the stream	It is unknown how much habitat is available to steelhead/rainbow trout in the Squilchuck watershed, given the many fish passage barriers created by dewatering and low flows conditions and the natural hydro-geologic conditions

Stemilt Creek

Table 60 Management plan recommendations for Stemilt Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Improve water flow in reach two	Work with existing water rights holders to conserve water or acquire rights	Goal to restore year-round flows	This would surely increase fish productivity; Maybe some can be convinced to sell their water rights thus allowing a minimum flow for fish in Reach 2	Highly unlikely that all landowners would sell their water rights
Eliminate obstructions to adult steelhead and Chinook migration	Locate and remove obstructions to fish migration	Allow access to spawning steelhead and salmon	Increase of habitat and likely the population	Landowner cooperation is unknown
Reduce the input of fine sediments	Change land use practices in the upper watershed	Reduce silt input will allow the creek substrate to eventually flush out some of silt currently present thus increase productivity of the creek	Increase in ground cover and controlled overland flow	This would require a change in agricultural practices That may or may not be acceptable to the public

Tarpiscan Creek

Table 61 Management plan recommendations for Tarpiscan Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

Tekison Creek

Table 62 Management plan recommendations for Tekison Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlifehabitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

Trinidad Creek

Table 63 Management plan recommendations for Trinidad Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of entire watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on the watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context
Eliminate obstructions to adult steelhead and Chinook migration	Provide a more defined channel across or remove the extensive alluvial fan	Allows access to spawning steelhead and salmon	Increased access to spawning and rearing habitat to one of the streams with the best water quality	Unknown landownership, high likelihood of use, but duration is unknown How long will it take before the an alluvial barrier may be formed?
Reduce the input of fine sediments	Change land use practices in the upper watershed	Reduced silt input will allow the stream substrate to eventually flush out some of silt currently present thus increase productivity of the stream	Enhanced habitat/fish productivity	This would require a change in agricultural practices That may or may not be acceptable to the public

Whiskey Dick Creek

Table 64 Management plan recommendations for Whiskey Dick Creek, WA.

Objective	Task	Rationale	Outcome	Uncertainty
Determine existing and potential fish use of watershed	Full stream investigation (survey) using the biological strategy protocols (PNAMP 2004)	Very little information exists on watershed	This will determine whether further funds for protection or restoration for fish resources is warranted This will also assist with wildlife habitat assessment as related to riparian areas	Funding and low prioritization in a region-wide context

6.2 Monitoring, Evaluation, and Adaptive Management

6.2.1 Terrestrial/Wildlife

Monitoring Methodology

Recommended monitoring and evaluation strategies contained below for each focal habitat type, including sampling and data analysis and storage, are derived from national standards established by Partners in Flight for avian species (Ralph et al. 1993, 1995) and habitat monitoring (Nott et al. 2003). Protocols for specific vegetation monitoring/sampling methodologies are drawn from USDA Habitat Evaluation Procedure standards (FWS 1980a,b). Wildlife managers will also apply statistically rigorous sampling methods to establish links between habitat enhancement prescriptions, changes in habitat conditions, and target wildlife population responses. A common thread in the monitoring strategies that follow is the establishment of permanent census stations to monitor bird population and habitat changes.

Specific methodology for selection of monitoring and evaluation sites within all focal habitat types follows a probabilistic (statistical) sampling procedure, allowing for statistical inferences to be made within the area of interest. The following protocols describe how M&E sites will be selected (from WDFW response to ISRP http://www.cbfwa.org/files/CCP/cascade/projects/199609400resp.pdf):

- Vegetation/HEP monitoring and evaluation sites are selected by combining stratified random sampling elements with systematic sampling. Project sites are stratified by cover types (strata) to provide homogeneity within strata, which tends to reduce the standard error, allows for use of different sampling techniques between strata, improves precision, and allows for optimal allocation of sampling effort resulting in possible cost savings (Block et al. 2001). Macro cover types such as shrubsteppe are further sub-cover typed based on dominant vegetation features (e.g., percent shrub cover). Cover type designations and maps are validated prior to conducting surveys in order to reduce sampling inaccuracies.

- Pilot studies are conducted to estimate the sample size needed for a 95% confidence level with a 10% tolerable error level (Avery 1975) and to determine the most appropriate sampling unit for the habitat variable of interest (BLM 1998). In addition, a power analysis is conducted on pilot study data (and periodically throughout data collection) to ensure that sample sizes are sufficient to identify a minimal detectable change of 20% in the variable of interest with a Type I error rate # 0.10 and P = 0.9 (Block et al. 2001, Hintze 1999, BLM 1998). Monitoring and Evaluation includes habitat trend condition monitoring on the landscape scale (Tier 1-HEP) and plant community monitoring (Tier 2) (i.e., measuring changes in vegetative communities on specific sites).

- For HEP surveys, specific transect locations within strata are determined by placing a Universal Transverse Mercator (UTM) grid over the study area (strata) and randomly selecting “X” and “Y” coordinates to designate transect start points. Random transect azimuths are chosen from a computer generated random number program, or from a standard random number table. Data points and micro plots are systematically placed along the line intercept transect at assigned intervals. Sample sizes for statistical inferences are determined by replication and systematic placement of lines of intercept within the strata with sufficient distance between the lines to assume independence and to provide uniform coverage over the study site.

- Permanent vegetation monitoring transect locations are determined by placing a UTM grid over the strata and randomly selecting “X” and “Y” coordinates to designate plot locations as described for HEP surveys. One hundred meter baseline transect azimuths are randomly selected from a random numbers table. Ten perpendicular 30 meter transects are established at 10 meter intervals along the baseline transect to form a 100m x 30m rectangle (sample unit). Micro plot and shrub intercept data are collected at systematic intervals on the perpendicular transects.

- Monitoring will be used to define habitat and species population trends and to determine if management actions have been carried out as planned (implementation monitoring). Results will be evaluated to determine if management actions are achieving desired goals and objectives (effectiveness monitoring) and to provide evidence supporting the continuation of proposed management actions.

Areas planted to native shrubs/trees and/or seeded to herbaceous cover will be monitored twice a year. Plant species will be systematically collected and analyzed for frequency, abundance, density, height, and percent cover to describe vegetative trends through time. In addition, the presence of all noxious weeds (e.g., diffuse knapweed, Dalmatian toadflax) will be mapped in GIS using Global Positioning System (GPS) equipment. This information will be used to identify causes of seeding or planting failure (e.g., depredation, weather impacts, poor site conditions, poor seed/shrub quality), modify planting methods and site preparation, develop an annual exotic vegetation control plan, evaluate the effectiveness of noxious weed control methods, and adjust management plans (adaptive management) accordingly.

Monitoring of habitat attributes and focal species in this manner will provide a standardized means of tracking progress towards conservation, not only within the UMM Subbasin, but within a national context as well. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in the subbasin planning process.

Overall Habitat and Species Monitoring Strategy

Establish monitoring programs for protected and managed focal habitat (shrubsteppe, eastside (interior) riparian wetland, and herbaceous wetland) sites to monitor focal species population and habitat changes and evaluate the success of efforts.

Focal Habitat Monitoring

Addressing factors that affect focal habitats (See Limiting Factors in Assessment section) will address focal species: Pygmy rabbit, sage thrasher, sage grouse, and sharp-tailed grouse, Willow flycatcher, Lewis' woodpecker, American beaver, and red-winged blackbird. If focal habitats are of sufficient quality, extent, and distribution to support focal species populations, the needs of most other focal habitat obligate species will also be addressed and habitat functionality could be inferred.

If sufficient habitat is present to support avian focal species, suitable habitat will be present to support beaver. Beaver will persist in these habitats if appropriate protection measures to preclude overharvest are implemented.

Working Hypothesis

The near term or major factors affecting wildlife focal habitat types are habitat fragmentation and loss, primarily because of conversion to agriculture and urban development, reduction of habitat diversity and function resulting from invasion of exotic vegetation, livestock overgrazing, and recreation. Shrubsteppe habitat has also been negatively impacted by wildfire suppression and increased fire frequency. The principal habitat diversity stressor is the spread and proliferation of invasive exotics. For instance, annual grasses and noxious weeds such as knapweed, Dalmation toadflax, cheatgrass, and yellow-star thistle have either supplanted and/or radically altered entire native bunchgrass communities within shrubsteppe habitat, significantly reducing wildlife habitat quality. These factors, coupled with poor habitat quality of existing vegetation, have resulted in extirpation and/or significant reductions in shrubsteppe, and riparian and herbaceous wetland obligate wildlife species.

Recommended Range of Management Conditions

Shrubsteppe

Pygmy rabbit, sage thrasher, sage grouse, and sharp-tailed grouse were selected to represent the range of habitat conditions of a functional shrubsteppe habitat complex to include:

1. *Deep soil shrubsteppe:* Pygmy rabbit was selected to represent species dependent on deep rock-free soil (greater than 20 inches deep) underlying shrubsteppe habitat with patches of dense tall sagebrush (average 32.7 percent shrub cover and shrub height of 32 inches).
2. *Sagebrush dominated shrubsteppe habitat:* The sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat. Suitable habitat includes 5 to 20 percent sagebrush cover greater than 2.5 feet in height, 5 to 20 percent native herbaceous cover, and less than 10 percent non-native herbaceous cover.
3. *Sagebrush habitat with diverse native herbaceous understory:* Sage grouse were selected to represent species that require/prefer diverse sagebrush habitat with medium to high shrub cover and residual grass. Sage grouse prefer slopes less than 30 percent, sagebrush/bunchgrass stands having medium to high canopy cover (10-30 percent), forb/grass cover at least 15 percent and less than 10 percent non-native herbaceous cover.

4. *Shrubsteppe habitat with multi-structured deciduous trees and shrubs:* Sharp-tailed grouse were selected to represent species that require multi-structured fruit/bud/catkin producing deciduous trees and shrubs dispersed throughout the landscape (10 to 40 percent of the total area). Other habitat conditions include:

- Native bunchgrass greater than 40 percent cover
- Native forbs at least 30 percent cover
- Visual obstruction readings (VOR) at least 6 inches
- At least 75 percent cover deciduous shrubs and trees
- Exotic vegetation/noxious weeds less than 5 percent cover

Eastside (Interior) Riparian Wetlands

Willow flycatcher, Lewis' woodpecker, and American beaver were selected to represent the range of habitat conditions of a functional riparian wetland and uplands habitat complex to include:

- Forty to 80 percent native shrub cover (greater than 50 percent comprised of hydrophytic shrubs), with scattered herbaceous openings, and tree cover less than 30 percent
- Forty to 60 percent tree/shrub canopy closure, shrub height greater than 6 6 feet and trees less than 6 inches DBH
- Mature cottonwoods greater than 21 inches DBH, 10-40 percent canopy cover, and 30-80 percent shrub cover

Herbaceous Wetlands

Red-winged blackbird was selected to represent the range of habitat conditions of a functional herbaceous wetland and uplands habitat complex to include:

- Permanent water present at a depth > 20"
- Emergent vegetation ≥ 0 25 acre with an optimum of open water to emergent vegetation ratio of 40:60
- Larvae of damselflies and dragonflies (order Odonota) present
- Surrounding uplands (≤ 200 yds.) should include sturdy, dense, robust herbaceous vegetation not disturbed by grazing, mowing, burning, haying etc.

Focal Habitat Monitoring Strategies

Establish inventories and long-term monitoring programs for protected and managed focal habitats to determine success of management strategies. Subbasin managers recognize that restoration of shrubsteppe is still very much a fledgling field, and complete restoration of degraded or converted shrubsteppe may not be feasible. These monitoring strategies reflect the commitment to and initiation of the process of long-term management.

- Identify shrubsteppe and riparian and herbaceous wetland habitat sites within the subbasin that support populations of focal species
- Evaluate habitat site potential on existing public lands and adjacent private lands for protection of focal species habitat (short-term strategy i e , < 2 years)
- Enhance habitat on public lands and adjacent private lands (intermediate strategy; 2 to 10 years)
- Identify high quality/functional privately owned shrubsteppe sites that are not adjacent to public lands (long-term strategy; 2 to 15 years)
- Establish permanent censusing stations to monitor focal species populations and habitat changes

Sampling Design

Permanent survey transects will be located within shrubsteppe habitats using HEP protocols. HEP is a standardized habitat-analysis strategy developed by the U.S. Fish and Wildlife Service. It uses a variety of Habitat Suitability Indices (HSI) for select wildlife species to evaluate the plant community as a whole (Anderson and Gutzwiller 1996). Sites are stratified by cover type, and starting points are established using a random number grid. Minimum length of a HEP transect is 600 ft, and patches of cover must be large enough to contain a minimum transect without extending past a 100 foot buffer inside the edge of the cover type. In addition, at any permanently established avian species monitoring site established within the Shrubsteppe habitat, structural habitat conditions will be monitored every 5 years as per Habitat Structure Assessment protocol (Nott et al. 2003).

Sampling Methods (FWS 1980a and 1980b)

(Sampling methods listed below apply to all habitat types except as noted)

- *Bare ground or cryptogram crust* (applies to shrubsteppe only) measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular $0.5m^2$ microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval. The percentage of the microplot consisting of either bare ground or cryptogram crust is estimated via ocular estimate.
- *Herbaceous* measurements are taken every 20 ft. on the right side of the tape (the right is always determined by standing at 0 ft and facing the line of travel). The sampling quadrat is a rectangular 0.5m2 microplot, placed with the long axis perpendicular to the tape, and the lower right corner on the sampling interval. In shrubsteppe habitat, herbaceous cover % is measured via an ocular estimate of the percentage of the microplot shaded by any grass or forb species.
- *Shrub* canopy cover is measured using a point intercept method and is visually estimated before starting each transect. If the total shrub cover is anticipated to be >20%, shrub data are collected every 5 ft (20 possible “hits” per 100 ft segment). If shrub canopy cover is anticipated to be <20%, data are collected every 2 ft (50 possible “hits” per 100 ft segment).

In shrubsteppe habitat, shrub canopy cover is measured on a line intercept 'hit' or 'miss' and measurements are taken every 2 or 5 feet, depending upon shrub density.

- *Shrub* height measurements are collected on the tallest part of a shrub that crosses directly above each sampling intercept mark. For shorter shrub classifications (i.e., all shrubs less than 3 feet), the tallest shrub is measured that falls within that category.
- *Tree* canopy cover measurements are taken every ten feet along a transect. Basal and snag measurements are taken within a tenth-acre circular plot at the end of each 100 ft segment. The center point of the circular plot is the 100 ft mark of the transect tape, and the radius of
- *Structural Habitat Conditions* will be measured every 5 years at permanently established avian species-monitoring sites within the herbaceous wetland habitat, as per Habitat Structure Assessment protocol (Nott et al. 2003).

Analysis

Transects are divided into 100 ft. segments, and total transect length is determined using a "running mean" to estimate variance (95% probability of being within 10% of the true mean).

Sample size equation: $n = \dfrac{t^2 \text{ x } s^2}{E^2}$

Where: t = value at 95 percent confidence interval with suitable degrees of freedom

s = standard deviation

E = desired level of precision, or bounds

For herbaceous wetlands:

Open water to emergent vegetation ratio is measured from high quality aerial photographs (Short 1985).

Presence of carp in the wetland is determined by seining, using local data about carp presence, or direct observations of carp or signs of their presence (Short 1985).

Focal Species Monitoring

Pygmy Rabbit (Shrubsteppe)

Sampling Strategy

Monitoring of pygmy rabbit populations is needed to provide baseline data to discern population trends, changes in distribution, and other population parameters. To avoid trapping and handling pygmy rabbits, trend data should be obtained through survey and classification of burrows (WDFW 1995).

Methods

Burrow surveys should be conducted between late fall and early spring, when pygmy rabbits are most closely associated with burrows. Estimates of active burrows over an entire habitat area are best obtained from randomly selected, circular plots that allow for 100% detection of active burrows. Pins driven into the ground mark plot centers at Sagebrush Flat and these should be used in surveys conducted annually. Burrow activity classification should be based on whether or not passages are open and recent tracks or fecal pellets are present (WDFW 1995). Application of this technique on the Sagebrush Flat Wildlife Area is described in WDFW (2004a).

Sage Thrasher (Shrubsteppe)

Sampling Strategy

Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 35% increase in abundance of key species with a power of 0.8 or greater.

Methods

Birds will be surveyed at sites in different vegetation types and levels of fragmentation. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established 200 meters apart along a transect. The outer points of the point-count circles will describe a rectangular plot of 16ha that will be the focus of all survey work in Objectives 2-4. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Sage Grouse and Sharp-tailed Grouse (Shrubsteppe)

Sampling Strategy

Male greater sage grouse and sharp-tailed grouse congregate during the spring on relatively traditional breeding sites, usually referred to as leks or lek complexes. Females visit these sites during the peak of the breeding season to select and copulate with males. These lek surveys are designed to be consistent with similar surveys being conducted on an annual basis in all western states with populations of either greater sage grouse or sharp-tailed grouse.

Methods

Methods are based on Washington Department of Fish and Wildlife grouse survey protocol (WDFW 2004b).

Sage grouse lek counts should consist of a complete count of male birds. The number of females should also be recorded when possible. There should be at least four counts of each lek spaced at seven to twenty one day intervals throughout the breeding season to account for the variation in male attendance. The first count should be in early to mid-March (depending on weather) and the last count should be in the latter third of April. The peak of breeding is about March 20, while the peak of male attendance is about a month later as young males become more established.

Sharp-tailed grouse leks are usually difficult to observe. Lek counts should consist of a complete count of birds and differentiate by sex when possible. There should be at least two counts of each active lek; with counts spaced at least ten days apart between March 10 and May 25. The peak of lek activity (i.e., female attendance and breeding) is early April in most years.

If a lek cannot be clearly observed without disturbance, then birds may have to be counted when flushed. Flushing is best accomplished with at least 2 observers or one person with a trained dog, as peripheral birds often will not flush if the observer is too far away. Males are often best counted returning to the leks. In many situations, a viewpoint is available that permits careful observation of birds with the aid of a spotting scope. Multiple counts of a large lek in a single morning may be needed to insure an accurate and consistent count. This can be done by scanning from left to right and then from right to left and then repeating the procedure 10-15 minutes later. Observers should be aware that young males and/or males on the edge of lek may be difficult to see. Likewise young males may be difficult to differentiate from females, even for greater sage grouse.

Lek counts should be conducted when the weather is good (wind < 10 MPH, no precipitation, temperatures > 20^{o}F, >50% bare ground). Weather matters less during the peak of the breeding season (late-March for greater sage-grouse and early April for sharp-tailed grouse). If the weather is not acceptable, it is likely the count will be abnormally low and have to be repeated.

Counts may be low if the birds are disturbed by predators, people, or unknown factors. Counts that appear to be abnormally low compared to previous years should be repeated. Sharp-tailed grouse are very likely to return to the lek 10-20 minutes following disturbance whereas greater sage grouse will often remain off the lek until the next morning.

Willow Flycatcher, Lewis' Woodpecker (Riparian Wetland), and Red-winged Blackbird (Herbaceous Wetland)

Sampling Strategy

Survey points will be placed among habitat types of interest using a stratified random design. Number of survey points in each habitat type will be determined using power analysis with the goal of being able to detect a 25% increase in abundance of willow flycatcher, Lewis' woodpecker, and red-winged blackbird with a power of 0.8 or greater. This protocol is based on the point count survey (Ralph et al. 1993, Ralph et al. 1995), with each survey station referred to as a "point count station." In addition to these bird survey data, information about the distance at which individual birds are detected will also be collected, allowing absolute density estimated to be made using distance-sampling methodology.

Methods

Birds will be surveyed on randomly selected (stratified) points along the riparian corridor and at herbaceous wetlands. Each site will have 4 100-m fixed-radius point counts (Ralph et al. 1993) established 200 meters apart along a transect. Each point will be marked with a permanent fiberglass stake (1m electric fence post) and colored flagging will be placed on shrubs at 50 and 100m from the point in each of the 4 cardinal directions to aid in determining distance. Counts at each point will be 5 minutes in duration during which all birds seen or heard will be noted, along with their sex (if known), distance from the point (within 50m, >50 but <100m, or beyond 100m), and behavior (singing, calling, silent, or flying over the site). Surveys will be conducted once each in May and June and within prescribed weather parameters (e.g., no rain and low wind).

Analysis

Analysis is described by Nur et al. (1999). Absolute density estimation (Buckland et al. 1993) can be estimated using the program DISTANCE, a free program available on the World-Wide Web (http://www.ruwpa.st-and.ac.uk/distance); an example is given in Nur et al. (1997). In brief: for species richness and species diversity, these can be analyzed as total species richness or as species richness for a subset of species; the same is true for species diversity. Species diversity can be measured using the Shannon index (Nur et al. 1999), also called the Shannon-Weiner or Shannon-Weaver index. Statistical analysis can be carried out using linear models (regression, ANOVA, etc.), after appropriate transformations (examples in Nur et al. 1999).

6.2.2 Aquatic/Fish

Working Hypothesis

The extent to which the small tributary watersheds can support salmon and steelhead/rainbow trout is most strongly limited by the natural hydrology in an arid environment, and geology and soil development that is relatively low. Because of the reliance on snow accumulation and snowmelt to support instream flows in the watershed and the high permeability of the soils, access to habitat is very limited. This condition is worsened during low water years. Surface water diversions contribute to dewatering and low flows in several of the tributaries, although three tributaries benefit from irrigation return flows. Given the natural geology of the watersheds, Chinook salmon use is naturally limited to the lowest reach of the streams before steeper channel gradient and shallower channels precludes upstream fish passage. Adult steelhead trout, being stronger swimmers and entering the drainage during spring runoff, could naturally penetrate higher into the watersheds on good water years, given passage at culverts and diversion dams. However, intermittent flows later in the year, coupled with severe habitat degradation present in some areas create significant limitations to steelhead/rainbow productivity in the tributaries.

Existing Monitoring Programs

The overall goal of the Monitoring and Evaluation Plan (M&E Plan) for the Mid-Columbia Hatchery Program (MCHP) is to determine the degree of success of the MCHP, or lack thereof, and to adjust the MCHP accordingly. Due to inherent, critical uncertainties (ability of physical facilities provided to meet needs of MCHP, potential risk imposed on native salmon and steelhead, and efficacy of MCHP to restore these populations) identified in the MCHP, an outline was developed to guide monitoring and evaluation efforts and to detect and potentially ameliorate problems encountered in implementation of the MCHP. The M&E Plan sets three specific objectives to obtain the data required to address each critical uncertainty (species-specific evaluations are discussed below): 1) Determine if the Mid-Columbia Hatchery Program is capable of meeting the Phase A production requirements of the Agreement; 2) Determine that actions taken under the Mid-Columbia Hatchery Program conserve the genetic integrity and long-term fitness of naturally spawning populations of salmon and steelhead in the Mid-Columbia Region; and 3) Determine if juvenile salmon and steelhead released from Mid-

Columbia hatcheries interact adversely with natural production in the Mid-Columbia Region (DCPUD 2002).

It is expected that these objectives, and their associated tasks, will form the basis for development of evaluation plans which will include details of the specific hypothesis to be tested, methods, analysis, and report development. The evaluation plans should be dynamic, with provision for assignment of new tasks directed at solving problems that may become apparent from the initial evaluations (DCPUD 2002).

Summer/Fall Chinook

Extensive monitoring and evaluation of the existing summer/fall Chinook salmon programs has been underway since 1992. These studies are expected to continue, and include any additional summer/fall Chinook salmon facilities or production groups developed in the MCHP. Specific study objectives are as follows: determine if Program facilities are capable of meeting the Phase A production objective and whether release-to-adult survival of fish is sufficient to achieve the Phase A plug number compensation; determine if actions conserve the reproductive success, genetic integrity, and long-term fitness of natural spawning populations of salmon in the Mid-Columbia Region; determine whether smolts released from the rearing and acclimation facilities disperse and migrate downstream without impacting the natural population (DCPUD 2002).

Spring Chinook

The evaluation plans for artificial propagation of spring Chinook salmon are aggregated into two components: the programs used for adult-based supplementation and those used for captive rearing of fish throughout their life history. Each component is meant to complement each other, provide information leading to adaptive management of spring Chinook salmon, and be useful in the evaluation and management of the other Plan Species in the Mid-Columbia Region. The evaluation plan for the adult-based supplementation component addresses the critical uncertainties and three objectives identified above and: Determine if hatchery facilities are capable of meeting their production objectives, if the MCHP conserves the genetic integrity and long-term fitness of naturally spawning populations of spring Chinook, and if salmon released from Mid-Columbia hatcheries interact adversely with natural productivity in the streams (DCPUD 2002).

Steelhead

The Hatchery Working Group recommended hatchery supplementation, with a transition from a single broodstock source to several locally adapted sources to recover steelhead populations at risk of extinction. A rapid transition may initially lessen hatchery production, and ultimately, natural escapement, so a well-defined evaluation plan that addresses the following questions is required to minimize impacts on the natural population: (1) does development of a local broodstock improve overall performance of hatchery released steelhead, (2) can residualism be controlled through various cultural techniques, (3) does acclimation differ from scatter plants in reducing impacts upon natural production, (4) do the hatcheries collect an appropriate sample of both natural and hatchery fish, and (5) what are the Natural Cohort Replacement Rates for selected supplemented populations in the region (DCPUD 2002).

The following evaluations strategy will help answer these questions (1) Implement a data base management system at each facility; (2) Evaluate fish cultural operations at each facility; (3)

Estimate reproductive potential of hatchery and natural steelhead in the river; (4) Assess the need to develop local broodstock, particularly on the Wenatchee River; (5) Monitor steelhead preparedness to migrate downstream at time of release; (6) Determine if the natural steelhead in the mid-Columbia tributaries genetically different from those produced in the hatcheries; (7) Determine the most effective allocation of production in a year of low adult returns (less than full seeding of habitat and broodstock collection requirements) (DCPUD 2002).

Sockeye

Most of the sockeye salmon evaluations for the MCHP will address the most effective means to increase natural production of the two rearing lakes. Specific questions to be addressed are: (1)What is the survival rate from release to emigration of juvenile sockeye salmon in Lake Wenatchee and, if the transboundary issue is resolved, in Lake Osoyoos? (2) What is the population size of hatchery and wild sockeye salmon that emigrate from Lake Wenatchee and, if the transboundary issue is resolved, Lake Osoyoos? (3) What is the smolt to adult survival rate for hatchery and wild sockeye salmon? and (4) In Lake Wenatchee, what release strategy for sockeye salmon reduces predation by bull trout? Additional evaluations will determine if the MCHP is capable of meeting the Phase A sockeye salmon production objectives (DCPUD 2002).

For the Lake Wenatchee production, these questions will be addressed through the following objectives: evaluate the release strategy for net pen reared sockeye; estimate populations of hatchery and wild juvenile sockeye emigrating from Lake Wenatchee; describe physical characteristics of Lake Wenatchee and the Wenatchee River that initiate emigration; determine the extent of predation/mortality during the release period, the post-release growth and fingerling-to-smolt survival rate of hatchery-reared juvenile sockeye, and determine the smolt-to-adult survival rate of Lake Wenatchee sockeye through extensive spawning surveys. Additional objectives were set to help hatcheries meet survival guidelines and production objectives of the MHCP. Biologists will determine the survival rates of various life stages of sockeye salmon at the hatchery and net pens. Fish health will also be monitored to develop cultural methods that alleviate fish health problems (PNAMP 2004).

Proposed Monitoring Programs

The proposed monitoring plan draws from existing monitoring strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB) and outlines an approach specific to the Upper Columbia Basin. The plan is designed to eliminate duplicate work, reduce costs, and increase monitoring efficiency, while addressing the following issues: current habitat conditions; abundance, distribution, life-stage survival, and age-composition of ESA-listed fish in the Upper Columbia Basin (status monitoring); how these factors change over time (trend monitoring); and effects that tributary habitat actions have on fish populations and habitat conditions (effectiveness monitoring) (PNAMP 2004).

The porposed monitoring plan report is divided into seven major parts. Section 2 identifies valid statistical designs for status/trend and effectiveness monitoring. Sections 3 and 4 discuss issues associated with sampling design. Section 5 identifies classification variables. Sections 6 and 7 identify and describe biological and physical/environmental indicators and methods for measuring each indicator variable. The last section deals with how the program will be implemented. The four appendices attached to the plan describe how the plan will be implemented within each of the four major subbasins within the Upper Columbia Basin. The

Plan does not include a detailed Quality Assurance/Quality Control (QA/QC) Plan (PNAMP 2004).

Finally, the success of this plan requires all organizations involved to cooperate and share information. This includes implementing valid sampling designs, following standardized data collection and reporting protocols, selecting sensitive indicators, and sharing monitoring responsibilities. See Appendix F for a complete copy of this document (PNAMP 2004).

6.2.3 Comprehensive Plans

(Information sourced from the following: Chelan County 2000, Grant County 1999, DCTLS 1995, Okanogan County 1964)

Comprehensive plans are required by the 1990 Growth Management Act (GMA). In response to increased pressures from unprecedented population growth in Washington State, the State Legislature passed the GMA. The GMA (RCW 36.70A) is intended to avoid the possibility of uncoordinated and unplanned growth inherent in anticipated population increases. It requires county and city governments to adopt locally-derived plans and regulations around a basic framework of natural resources issues defined by the state legislature. One of the primary intents of the GMA is to prevent unwise use of natural resource and critical areas in accommodating urban growth. Each jurisdiction must classify and designate their resource lands and critical areas, and each must adopt development regulations for their critical areas. In addition, some jurisdictions must adopt planning policies and comprehensive plans that address many aspects of urban growth and development that are expected to occur in the county, including land use, housing, utilities, transportation, and others. Subsequent amendments to the GMA require that counties and cities include the best available science in developing policies and development regulations to protect the functions and values of critical areas. In addition, counties and cities must give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries. GMA and Shoreline Management Act (SMA) adoption, revision, and review dates for UMM Subbasin counties are detailed in Table 65.

Table 65 GMA and SMA adoption, revision, and review dates for UMM Subbasin counties

Description	Dates	Chelan County	Douglas County	Grant County	Kittitas County	Okanogan County4	Colville Tribes5
CAO[1]	Adoption[2]	1999	1992	1993	1998	1994	
	Most Recent Revision	2000	2003[3]				
	Next Required Revision	2006	2006	2006	2006	2007	
Comprehensive Plans	Adoption[2]	2000	1995	1999	1996	1964	
	Most Recent Revision	2000	2003[3]				
	Next Required Revision	2006	2006	2006	2006	2007	
Development Regulations	Adoption[2]	2000	1997	2000	1999		
	Most Recent Revision	2000	2003[3]				

Description	Dates	Chelan County	Douglas County	Grant County	Kittitas County	Okanogan County4	Colville Tribes5
	Next Required Revision	2006	2006	2006	2006	2007	
Resource Lands	Adoption[2]	1999	1992	1993	2001	1994	
	Most Recent Revision	2000	2003[3]				
	Next Required Revision	2006	2006	2006	2006	2007	
SMA	Adoption[2]	1972	1972				2000
	Next Required Revision	2005[6] /2013	2005[6] /2013	2013	2013	2014	

[1] CAO = Critical Area Ordinance.

[2] Original adoption dates since legislation for Growth Management Act (GMA) in 1990. The Shoreline Management Act (SMA) was originally adopted by legislature in 1970, completely overhauled Dec. 2003. Generally, cities all have respective dates of adoption for GMA and SMA plans associated to their county's adoption.

[3] For those jurisdictions deciding to plan earlier than required, the most recent revision may have been intended to fulfill the requirement (i.e., dates for local planning review requirements have changed several times over the last 5 years).

[4] Okanogan County is not required to address all of the elements of the GMA.

[5] The Colville Tribes are not under the authority of the State of Washington, but do have their own Comprehensive Plan and Shoreline Plan.

[6] Chelan and Douglas counties are expecting to start a review /update of their Shoreline Master Program in 2005.

The Washington Department of Fish and Wildlife (WDFW) has biologists in five of its six regions that provide technical assistance to local jurisdictions in complying with the requirements of the GMA regarding fish and wildlife resources. One of the primary goals of WDFW is to integrate its Priority Habitats and Species (PHS) program into the local jurisdictions' GMA planning activities. The GMA requires the fastest growing counties to adopt new comprehensive land use plans in compliance with the new law and to address the following 13 goals (RCW 36.70A.020):

Goal (1) Urban Growth – Encourage development in urban areas where adequate public facilities and services exist or can be provided in an efficient manner.

Goal (2) Reduce Sprawl – Reduce the inappropriate conversion of undeveloped land into sprawling, low-density development.

Goal (3) Transportation – Encourage efficient multimodal transportation systems that are based on regional priorities and coordinated with county and city comprehensive plans.

Goal (4) Housing - Encourage the availability of affordable housing to all economic segments of the population of the state, promote a variety of residential densities and housing types, and encourage preservation of existing housing.

Goal (5) Economic Development - Encourage economic development throughout the state that is consistent with adopted comprehensive plans; promote economic opportunity for all citizens of the state, especially for unemployed and disadvantaged persons; and encourage growth, all within the capacities of the state's natural resources, public services, and public facilities.

Goal (6) Property rights - Private property shall not be taken for public use without just compensation having been made. The property rights of landowners shall be protected from arbitrary and discriminatory actions.

Goal (7) Permits - Applications for both state and local government permits shall be processed in a timely and fair manner to ensure predictability.

Goal (8) Natural Resource Industries – Maintain and enhance natural resource-based industries, including productive timber, agricultural, and fisheries industries. Encourage the conservation of productive forest lands and productive agricultural lands, and discourage incompatible uses.

Goal (9) Open Space and Recreation – Encourage the retention of open space and development of recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands, and discourage incompatible uses.

Goal (10) Environment – Protect the environment and enhance the state's high quality of life, including air and water quality, and the availability of water.

Goal (11) Citizen Participation and Coordination - Encourage the involvement of citizens in the planning process and ensure coordination between communities and jurisdictions to reconcile conflicts.

Goal (12) Public Facilities and Services – Ensure that those public facilities and services necessary to support development shall be adequate to serve the development at the time the development is available for occupancy and use without decreasing current service levels below locally established minimum standards.

Goal (13) Historic Preservation – Identify and encourage the preservation of lands, sites, and structures that have historical or archaeological significance.

A comprehensive plan is a legal document adopted by local elected officials establishing policies that will guide the future development, growth, and land use within the counties over the next 20 years. The Plans strive to maintain the uniqueness of each area/community and enhance the existing quality of life that comes from a sense of community, customs, economic progress, open spaces, aesthetic/scenic beauty, recreational opportunities, clean air and water, abundant fish and wildlife, healthy ecosystems, historical and cultural resources, and increased access to land and water resources. In addition, the Plans provide for expansion of these opportunities, while maintaining an adequate infrastructure to accommodate this growth.

Comprehensive plans [Plan(s)] are typically broken down into elements: land use, transportation, capital facilities, economic development, utilities, and rural. The following are summaries of the Chelan, Douglas, Grant, and Okanogan County Comprehensive Plans by element. These summaries focus on commonalities and differences among the Plans.

Land Use Element

Natural Systems / Critical Areas

The Plans provide for the protection of critical areas, which include the following areas and ecosystems: (a) wetlands; (b) groundwater resources and aquifer recharge areas; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas known to be critical parts of the natural drainage system; and (e) geologically hazardous areas. The land use element is also required by the GMA to review; where applicable, drainage, flooding, and storm water run-off and to provide guidance for corrective actions to mitigate for those discharges that pollute waters of the state.

Plan goals help to identify and protect critical areas, and provide for reasonable use of private property while mitigating adverse environmental impacts. This includes protecting the quality and quantity of ground water used for public water supplies, preserving frequently flooded areas by limiting and controlling potential alterations and / or obstructions to those areas, and avoiding or mitigating significant risks that are posed by geologic hazard areas to property (public and private), health, and safety. They also ensure that development minimizes impacts upon significant natural, historic, and cultural features and preserves their integrity.

Resource Lands

County goals assure conservation and continued use of agricultural, forest, and mineral resource lands that have long-term significance for commercial production. The Plans provide for reasonable, limited use of designated resource lands that are compatible with the long-term production of natural resource products. They also facilitate a healthy, diverse, and competitive agricultural industry, control encroachment of incompatible uses and ensure public health and safety. Grant County calls for the mitigation of conflicts between resource and non-resource land uses in designated resource lands.

Resource lands in Douglas and Grant counties include agricultural and mineral lands. Forestlands have not been included because they do not meet the minimum criteria for lands of "long-term commercial significance" within these two counties.

Residential Development

While recognizing that residential development is important and necessary to the sustainability of the communities, housing goals were developed to ensure that future development is compatible with surrounding land uses and can be efficiently and effectively served by public facilities and services. In addition, residential designations shall provide for an adequate supply of land to accommodate housing needs, and a variety of residential opportunities to serve a full range of income levels. The Okanogan Plan also calls for maximum utilization of the land.

Urban Growth Areas

The GMA stipulates that UGAs are to include areas and densities sufficient to permit the urban growth that is projected to occur in the County over a twenty year planning period. Urban growth is encouraged within designated Urban Growth Areas (UGAs) (areas already characterized by urban development where existing public facility and service capacity is available). Otherwise, in areas where public or private facilities or services are planned or could be provided and used in an efficient manner. Grant county also states that UGAs should concentrate medium- and higher-intensity residential, commercial and industrial development in a way that ensures livability, protection of cultural resources, and preservation of environmental quality, open space retention, varied and affordable housing, and high quality urban services at the least cost, and orderly transition of land from county to city. In this way the counties are also able to achieve their goal of an orderly, phased transition from rural to urban uses (see Population of Subbasin Counties).

Commercial and Industrial Development

Similar goals apply to commercial and industrial development. Commercial and industrial development is limited to areas zoned for these activities within the urban growth boundaries (areas with the infrastructure and services to support such development) and in rural lands when consistent with the GMA. County goals maintain the existing commercial and industrial base and promote further diversification, while maintaining compatibility with surrounding land uses. The Okanogan Plan requires heavy industrial areas to be buffered from all other uses so as to not create any adverse effects on other types of land use.

Additionally, commercial and industrial goals call for the designation of adequate areas, which will allow for a range of opportunities and the diversification of area economies. They also require the mitigation of impacts on other land uses and the community, where appropriate. A goal of the Chelan Plan is to retain docking facilities at the Stehekin Landing for both commercial and private use.

Open Space / Recreation

Plan goals encourage the retention of open space (underdeveloped land that helps define the rural character of the County), the development and maintenance of recreational facilities to meet the needs of residents and tourists, and the coordination of federal, state, local, and private planning. Plans also provide for public access to recreation sites and the reasonable, limited use of privately-owned land within the Open Space designation, provided that such development is reasonably compatible with open space recreation and fish and wildlife habitat conservation (Douglas).

Plans also specify that park and recreation planning and development should take into consideration impacts on surrounding land uses, critical areas, and significant natural, scenic, historic, and cultural features. For instance, the Okanangan Plan assures that the density of urban and recreational development in areas with stream and lake frontage where no public sewerage and water facilities are available is low enough to prevent the pollution of streams and the lowering of water tables.

Master Planned Resorts

Another objective of the plans is to provide opportunities for Master Planned Resorts (MPRs: destination resort facilities that may be located outside of the UGA) consistent with the provisions of RCW 36.70A.360. These opportunities include encouraging and enhancing a diversity of recreational, lodging, and economic opportunities, and providing resorts in existence as of July 1, 1990, which match the definition of an MPR, a means to be classified as such. The plans also require that development regulations governing the review of MPRs shall incorporate appropriate environmental and design standards.

Transportation Element

Transportation goals provide for the efficient use of existing and future transit facilities for all citizens through a systematic approach of monitoring and maintaining the transport systems. The goals integrate many types of transportation systems and facilities (e.g., road, rail, air, bike, pedestrian, etc.) and establish levels of service, by coordinating transportation planning with other elements of the comprehensive plan (e.g., land use and rural areas), and coordination with other jurisdictions and transportation providers to meet shared needs. They also promote safe, efficient access to land, while maintaining the integrity and minimizing impacts of the transportation systems, and providing for the health and economic well-being of county citizens. Transportation improvements and development are provided through a fiscally sound approach that stays within the counties funding capacity. Finally, the Plans provide for a systematic process for reviewing and updating the Transportation Improvement Program.

The transportation element for Okanogan County is more general in nature and deals only with arterials. Goals for management of arterials are similar to other counties in that they contain proposals relating to the standards and locations of roads and tie road use to present and future land use and public facilities within the county. In addition, they call for cost effective construction and maintenance of streets.

The Okanogan Plan also alludes to other potential goals related to implementation of the arterial plan. They include, encouraging travel on the designated arterials through use of arterial standards in design and construction (e.g., properly located signs - “stop” and “yield”; giving preference to major arterials), and by adopting and enforcing subdivision regulations.

The Okanogan Plan devotes an entire section to road planning. Their goal is to assure that roads into future urban, recreational, and agricultural areas will be of a sufficient standard and width to meet present and future needs (Okanogan).

Planning for other forms of transportation are not addressed in the Okanogan Plan except for air travel. Airport planning is included within the public facilities element and focuses on enhancing a number of undeveloped airstrips (Oroville, Tonasket, Okanogan, and Brewster) in order to attract tourist activity, enhance economic well-being, and improve quality of life. The Pangborn Memorial Airport, a regional facility, has its own comprehensive plan that, as required, is developed and consistent with the Douglas County Comprehensive Plan.

Capital Facilities Element

Plan goals ensure that adequate public facilities and services (e.g., fire, police, water, sanitary sewer, storm water, schools, hospitals, parks, etc.) are planned, located, designed and maintained in a timely, economical, efficient, and equitable manner, according to future development of the county and in coordination with other elements of the comprehensive plan (e.g., land use and transportation) and other jurisdictions. This includes: establishing and achieving levels of service standards; encouraging compatible, multiple uses of public facilities; maximizing use, including rehabilitation of existing facilities and replacing worn out or obsolete facilities, when and where feasible; ensuring funding for facilities and services that are within the counties capacity; and encouraging land use patterns that minimize (make reasonable) the cost of providing facilities and services. Douglas County requires developments to pay for their fair share of impacts on capital facilities and to maintain service standard levels. The Chelan County Plan encourages participation in, and the establishment of, a regional forum to address area wide public facility and service and utility needs as they arise.

With regard to environmental protections, the Chelan County Plan ensures that public services and facilities are adequately planned and designed to prevent significant negative environmental impact, to assure access, and to protect public health, safety and welfare. Specifically, the county supports and encourages water conservation education and measures, energy conservation design strategies, and the design of facilities and services that are in keeping with the rural and scenic character of the county. Also, fire provisions provide for proper disposal of vegetative debris associated with capital development. Douglas County requires mitigation to prevent adverse impacts on the environment and other public facilities resulting from the design and location of public facilities and they promote user respect and care for recreation resources and facilities.

The public facilities element of the comprehensive plan for Okanogan County is less comprehensive than the other plans, focusing primarily on future development of the county's parks, schools, and water and sewer facilities. The technical design and construction does not fall within the scope of the plan except for the fact that they should be coordinated with the comprehensive plan to insure that the facilities will be adequate to handle future demands.

The Okanogan County Plan devotes more attention to recreational development than the other plans because it offers the highest potential of any economic activity for future improvement of the county's economic base. The Plan suggests sites, priorities, and types of recreation facilities needed and encourages development by private groups, individuals and public agencies for the use of both tourists and county residents. The planning process also considers varied means of securing and preserving the proposed parks, as well as providing access, while preventing encroachment from incompatible uses.

There are several other types of public facilities in Okanogan County that also need development. These other facilities include county road district shops, airports, garbage dumps, and gravel pits. Plan goals call for the relocation of road district shops to the industrial sections of the towns and location of garbage dumps to limit negative impacts on sight, smell, and health on citizens and the environment. Airports are included in the transportation element of this report.

At present Okanogan County does not have any sewerage and water controls. There are several areas within the county (e.g., Elmway Area between Omak and Okanogan; the west shore of Lake Osoyoos; Malott and Loomis) that are beginning to have, or will have in the near future, problems relating to water and sanitation. The plan states that it is imperative for the future health and welfare of the residents of Okanogan County that adequate sanitation regulations be implemented and enforced by the county.

Economic Development Element

County goals are designed to increase efforts to support, retain, and expand the existing agricultural industry (includes expanding value-added agricultural products) and other local business, while diversifying the economy by promoting other opportunities for economic development that provide diverse work opportunities and job security, and ensure a healthy, stable, growing economy. The plans seek to attract businesses and industries that complement and build upon existing enterprises and those that conserve natural resources and open spaces, maintain environmental quality and rural character, and enhance the overall quality of life. Development of tourism and recreation was a key goal for each of the counties.

County Plans also encourage economic growth through other means. They propose to involve citizens and other jurisdictions in the creation of decisions/direction for future growth in economic development including educational partnerships that provide the technically skilled labor force to attract and retain good paying industries. They encourage economic growth through planning and development of the region's public services and facilities' capacity and they pursue legislative changes (including tax increment financing) and provide regulatory incentives to foster public/private partnerships and economic development.

The counties also have individual needs and requirements that are expressed in their goal statements. Douglas County supports and encourages development that creates local re-investment funds, and growth of non-resource industries that are consistent with local quality of life issues. Chelan County recognizes the need to be proactive in addressing ESA listings and entering into watershed planning efforts because of their potential impact on economic development efforts and the ability to pursue sustainable economic development. They will also work to retain and develop their site limited industrial sector and to diversify the local economy by strengthening manufacturing and promoting producer services and other basic industries. Grant County will focus business recruitment and development on firms that will diversify the local economy and can effectively serve state, national, Pacific Rim and other global markets from a Grant County location. To facilitate this process, they will ensure an adequate supply of commercial and industrial sites, encourage high value-added resource based products and businesses, and encourage the establishment of industrial parks and other light manufacturing facilities and provide zoning of facilities engaged in producer services, including computer, health services, and telecommunications.

The Douglas County Plan emphasizes the need to develop and implement land use regulations that are flexible enough to recognize the changing nature of business and industry. The Plan supports phased infrastructure development and the designation of lands for commercial industrial development in rural and industrial service centers where there is evidence of community support. It also allows the designation of light manufacturing and other industrial development in areas without sanitary sewer, but where acceptable and adequate alternative disposal facilities can be provided. Further, the Plan proposes developing a process for authorizing the siting of new major industrial developments outside of designated Urban Growth Areas that is consistent with the provisions of RCW 36.70A.365 and pursuant to the Countywide Planning Policy.

The Okanogan Plan does not include an economic development section. Rather, goals pertaining to economic development are general in nature and are encompassed within the other comprehensive plan elements discussed herein.

Housing Element

Housing goals provide for the adequate supply of affordable housing in a variety of prices, densities, and types, to meet the needs of existing and projected populations of all economic segments within these counties and as a means of attracting industry. To conserve current housing resources and maximize their use, the Plans encourage the appropriate preservation of existing housing stock and, where appropriate, provide for higher density residential housing developments within existing residential communities and urban growth areas where adequate infrastructure and services can be provided. Plans also call for innovative regulatory strategies that can create incentives for developers to provide housing affordable to low and moderate income households.

Agriculture is a significant economic activity in these counties and Douglas and Chelan County Plans require necessary support services and facilities to be accommodated in order for the industry to remain economically viable. This includes the construction of year-round and seasonal agricultural worker housing units. Douglas County encourages innovative, viable housing opportunities for agricultural workers, both on the farm site and within the community, while Chelan County calls for housing located in or adjacent to orchard areas. When farmers provide agricultural housing on-site, Douglas County states that local regulations and requirements guiding the development of housing should promote the health and safety of the targeted inhabitants, while still recognizing the temporary, seasonal nature of the facilities. In contrast, Chelan County encourages planners to consider the reduction of site development and fire protection standards for temporary housing units for migrant workers, where permitted by state agencies.

Utilities Element

County utility goals promote increased efficiencies and quality service, multi-jurisdictional cooperation, coordination with other elements of the comprehensive plan (e.g., land use and transportation), and the provision of adequate, timely, safe, and cost effective utilities (e.g., power, water, sewer, telecommunications and, in some areas, irrigation) to support current and future development. This includes identifying the proper location of utilities, minimizing cost and disruption of normal activities, increasing effectiveness of the resource, and protecting the public and environment from negative impacts associated with the siting, development, and operation of utility services and facilities. Counties will also promote the continued use, maintenance, development and revitalization of existing utilities whenever possible. Utility development regulations should be flexible, receptive to innovations, and based on specific situations. Grant County encourages the location of necessary utility facilities within existing and planned transportation and utility corridors and the joint use of transportation rights-of-way, provided that such joint use is consistent with limitations as may be prescribed by applicable law and prudent utility practice.

With respect to maintaining the quality of life and the environment, the Chelan and Grant County Plans state utilities should be provided in a manner that minimizes negative visual and noise impacts and, where facilities may have negative impacts, regulations shall provide for adequate buffering and screening of facilities. They also encourage energy conservation, including new construction, and the use of cost effective alternative energy sources (e.g., solar and wind power). Further, Grant County requires that utility providers avoid placement of facilities in areas designated as environmentally sensitive or critical areas unless no feasible alternative exists and only after a site assessment and mitigation plan has been approved under the provisions of Grant County’s Resource Lands and Critical Areas Ordinance.

Chelan County has set guidelines specific to the Stehekin Study Area. These goals encourage the continued use and maintenance of hydroelectric facilities and the enhancement of hydroelectric power capabilities through system efficiency and the protection of facilities from erosion and flooding. Further, they seek to decrease future reliance upon diesel powered electricity by encouraging the use of alternative energy sources.

The Okanogan Plan does not include a separate discussion of utilities. Water and sewer are discussed within the capital facilities section and there is no specific mention of power or water. There are a number of references within various sections of the Plan to the provision of utilities. These deal primarily with the efficient and cost effective location and development of utilities in coordination with an orderly outward growth of urbanizing areas.

Rural Element

Rural areas are those areas not designated for urban growth, agriculture, forest, or mineral resources. However, agriculture, farming/ranching, forestry, mineral, recreation and other similar activities are inherent within this designation. Plan goals take into consideration both human uses and the natural environment. They encourage rural development that maintains the rural character and visual integrity of the land and protects and restores the land and water environments required by natural resource-based economic activities, fish and wildlife habitats, rural lifestyles, outdoor recreation, and other open space. Other primary stipulations for rural development include developing at low levels of intensity, ensuring that the provision of public facilities and services are consistent with rural character and lifestyle, reducing the inappropriate conversion of rural lands to sprawling low-density development, and promoting coordination with other jurisdictions and sections of the plan.

Comprehensive Plans provide for a variety of rural densities and designations, while striking a balance between maintaining the existing pattern of uses (e.g., residential, small-scale commercial, cottage and resource industries, tourism, recreation, agricultural, light industrial and limited natural resource processing, sales, and support services) and providing opportunities for future, compatible development. To accomplish this, counties will promote the continuation and enhancement of clustering (i.e., MPRs, designated rural service centers fully contained communities), density transfer, design guidelines, conservation easements, and other innovative techniques. Open space will be part of the development in order to protect rural values and buffer adjacent resource use/critical areas. Also, whenever feasible, rural developments will be encouraged to use community systems for domestic water and sewage disposal to increase efficiency, lower costs of providing these services, and to cause fewer impacts on the environment (e.g., aquifer recharge areas, water quality and quantity). Development and recreational opportunities in rural shoreline and other rural areas shall minimize potential adverse impacts on water quality, slope stability, vegetation, wildlife and aquatic life.

The Okanogan Plan does not deal specifically with rural designated lands. Much of Okanogan County is sparsely settled and most of the recommendations contained in the plan pertain to areas of population concentration and intensive agriculture in the Okanogan, Methow, and Columbia River Valleys; and to areas of present and potential recreational value such as the Upper Methow Valley and land along the county's major lakes and streams.

6.3 Research

6.3.1 Aquatic/Fish

More information is needed to determine proper management strategies and how to direct funds and efforts to effectively improve habitat conditions in the tributaries. Currently it is unknown what effect other factors such as year-round water quantity and quality have on salmonid production.

Comprehensive studies of water quality are needed to establish baseline data and to determine the effects of water conditions on productivity. More information is needed on year–round flows, water temperatures, the location and effects of water diversions on year–round flows and water temperatures, watershed land use practices, blockages to migration, and chemical contaminants (from agricultural lands and other sources).

Because the ultimate goal is to increase rainbow/steelhead and salmon abundance, base line information concerning fish population size and composition and macroinvertebrate populations needs to be established prior to any habitat work. Without this information it will be impossible to monitor and evaluate the effects of any habitat improvement efforts. Aquatic macroinvertebrate species composition, diversity, and abundance vary based on differences in water quality and ecosystem productivity. Establishing base line information concerning invertebrate populations and monitoring any changes to these populations over time provides a useful means to measure any increases or decreases in system productivity because of efforts to improve water quality or habitats. An example would be to increase nutrient input (i.e., increased input of vegetation) through restored riparian vegetation. Base line information also needs to be colleted concerning sediment characteristics, particularly fine sediment and embeddedness. Management recommendations for future research on bull trout, white sturgeon, and Pacific lamprey are as follows:

Bull Trout

Improve current knowledge base on bull trout throughout the Upper Middle Mainstem of the Columbia River Watershed.

- Complete a bull trout fish use study in the Upper Middle Mainstem of the Columbia River.
- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River

White Sturgeon

- Determine the location and degree of spawning throughout the Columbia River from Wanapum Dam to Chief Joesph Dam.
- Determine the degree of predation by native and non-native species on larval sturgeon.
- Determine effects of hydro-electirc project on all life stages
- Determine how flows affect existing spawning habitat and rearing success.
- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River.
- Determine the effects of a supplementation progam on thecurrent population.
- Pacific Lamprey
- Determine effects of passage through the hydroelectric projects and how the project areas may be modify to facilitate more success

- Determine migration periods of Pacific lamprey through the system and in to the tributaries.
- Determine effects of hydro-electirc project on all life stages.
- Complete a life history study throughout the Upper Middle Mainstem of the Columbia River.
- Improve enumeration of lamprey at the hydro-electric projects.
- Conduct adult telemetry studies to determine population distribution.

All projects conducted to alter habitat to improve the productivity of an aquatic system should have a monitoring and evaluation component. The ability to evaluate the consequences of any habitat alteration is needed not only to determine the effectiveness of these efforts but also to provide understanding that would, if needed, lead to adaptive management strategies that would better achieve the desired outcome.

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8 Acronyms and Abbreviations

BLM	Bureau of Land Management
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
BiOP	Biological Opinion
CCP	Columbia Cascade Province
CCPUD	Chelan County Public Utility District
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
Colville Tribes	Confederated Tribes of the Colville Reservation
CRITFC	Columbia River Inter-Tribal Fish Commission
CRMP	Cultural Resources Management Plan
CWA	Clean Water Act
DCTLS	Douglas County Transportation and Land Services
DNR	Washington State Department of Natural Resources
DO	Dissolved Oxygen
DOE	U. S. Department of Energy
DOI	U.S. Department of the Interior
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
ECP	Eco-regional Conservation Planning
EDT	Ecosystem Diagnostic & Treatment
EIS	Environmental Impact Statement
EMS	Energy Management System
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
GCPUD	Grant County Public Utility District

GIS	Geographic Information System
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure
HGMP	Hatchery Genetic Management Plan
huc	habitat
IBIS	Interactive Biological Information System
ISRP	Independent Scientific Review Panel
JFC	Joint Fisheries Committee
LFA	Limiting Factors Analysis
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPPC	Northwest Power Planning Council
ODEQ	Oregon Department of Environmental Equality
PA	Programmatic Agreement
PIT	Passive Integrated Transponder
PNAMP	Pacific Northwest Aquatic Monitoring Project
PUD	Public Utility District
RC&D	North Central Washington Resource Conservation & Development Council
RM	River Mile
RV	Recreational Vehicle
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TDG	Total Dissolved Gas
TMDL	Total Maximum Daily Load
TSS	Total Suspended Sediment
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WQI	water quality index
WDFW	Washington Department of Fish and Wildlife

WSCC	Washington State Conservation Commission
Yakama Nation	Confederated Tribes and Bands of the Yakama Indian Nation
YFRM	Yakama Fisheries Resource Management

9 Technical Appendices

Appendix A. Known High Quality or Rare Plant Communities and Wetland Ecosystems

Appendix B. Wildlife and Fish Species

Appendix C. Focal Species Information, Red-winged Blackbird

Appendix D. Conservation Reserve Program

Appendix E. Water quality parameters affected by hydropower production

Appendix F. Pacific Northwest Aquatic Monitoring Patnership